Ordinance No. 2003-2

HILLTOWN TOWNSHIP STORMWATER MANAGEMENT ORDINANCE

Hilltown Township
Bucks County, Pennsylvania

May 8, 2003

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ARTICLE 1. GENERAL PROVISIONS

Section 101. Statement of Findings

The governing body of the municipality finds that:

A. Inadequate management of accelerated stormwater runoff resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, degrades water quality, overtaxes the carrying capacity of existing streams and storm sewers, greatly increases the cost of public facilities to convey and manage stormwater, undermines floodplain management and flood reduction efforts in upstream and downstream communities, reduces groundwater recharge, and threatens public health and safety.

B. A comprehensive program of stormwater management, including reasonable regulation of development and activities causing accelerated erosion, is fundamental to the public health, safety, welfare, and the protection of the people of the municipality and all the people of the Commonwealth, their resources, and the environment.

Section 102. Purpose

The purpose of this comprehensive stormwater management ordinance is to promote health, safety, and welfare within Hilltown Township by minimizing the damages described in Section 101.A of this Ordinance through provisions designed to:

A. Manage accelerated runoff and erosion and sedimentation problems at their source by regulating activities that cause these problems.

B. Utilize and preserve the existing natural drainage systems.

C. Maintain the pre-development volume of groundwater recharge and prevent degradation of groundwater quality.

D. Maintain the pre-development peak and volume of stormwater runoff and prevent degradation of surface water quality.

E. Minimize nonpoint source pollutant loadings to the ground and surface waters.

F. Minimize impacts on stream temperatures.

G. Maintain existing flows and quality of streams and watercourses in the municipality and the Commonwealth.

H. Preserve and restore the flood-carrying capacity of streams.

I. Provide proper maintenance of all permanent stormwater management facilities that are constructed in the municipality.

J. Provide performance standards and design criteria for watershed-wide stormwater management and planning.

Section 103. Statutory Authority

The municipality is empowered to regulate land use activities that affect runoff by the authority of the Act of October 4, 1978 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq., as amended, the 'Storm Water Management Act,"; and by the Authority of Pennsylvania Municipalities Planning Code, Act 247 of 1968, as amended by Act 170 of 1988, as further amended by Act 209 of 1990 and Act 131 of 1992, 53 P.S. Section 10101.

Section 104. Applicability

This Ordinance shall apply to all areas of the municipality that are located within the Neshaminy Creek Watershed, Tohickon Creek Watershed, or Delaware River (South) Watershed as delineated in Appendix D which is hereby adopted as part of this Ordinance.

This Ordinance shall apply to temporary and permanent stormwater management facilities constructed as part of any of the regulated activities listed in this section. Stormwater management and erosion and sedimentation control during construction activities which are specifically not regulated by this Ordinance, shall continue to be regulated under existing laws and ordinances.

This Ordinance contains only the stormwater management performance standards and design criteria that are necessary or desirable from a watershed-wide perspective. Stormwater management design criteria (e.g. inlet spacing, inlet type, collection system design and details, outlet structure design, etc.) shall continue to be regulated by applicable ordinances.

The following activities are defined as 'Regulated Activities' and shall be regulated by this Ordinance except as exempted by Section 105 of this Ordinance:

A. Land development.
B. Subdivision.
C. Construction of new or additional impervious surfaces (driveways, parking lots, etc.) which exceed 1,000 square feet in area.
D. Construction of new buildings or additions to existing buildings which exceed 1,000 square feet in area.
E. Diversion or piping of any natural or man-made stream channel.
F. Installation of stormwater management facilities or appurtenances thereto.
G. Temporary storage of impervious or pervious material (rock, soil, etc.) where ground contact exceeds 5 percent of the lot area or 5,000 square feet (whichever is less), and where the material is placed on slopes exceeding 8 percent.

Section 105. Exemptions

A. Any Regulated Activity that meets the following exception criteria may be exempt from the requirements of Section 303.A of this Ordinance. This exemption shall not relieve the landowner and/or developer from complying with water quality and groundwater recharge standards under Section 303.C and the special requirements under Section 304.R for areas within Exceptional Value and High Quality sub-watersheds. Further, this exemption shall not relieve the applicant from implementing such measures as are necessary to protect health, safety, and property. These criteria shall apply to the total development even if development is to take place in phases. The date of adoption of this Ordinance shall be the starting point from which to consider tracts as "parent tracts" in which future subdivisions and respective impervious area computations shall be cumulatively

considered. Exemption shall not relieve the applicant from implementing such measures as are necessary to protect health, safety, and property.

Stormwater Management Exemption Criteria

Total Parcel Size	Minimum Distance (ft.)*	Impervious Area Exemption (sq. ft.) (Maximum)
0 - 0.5 acre	10 ft.	1,200 sq. ft.
> 0. 5 -1 acre	50 ft.	2,500 sq. ft.
> 1 - 2 acres	100 ft.	4,000 sq. ft.
> 2 - 5 acres	250 ft.	5,000 sq. ft.
> 5 acres	500 ft.	7,500 sq. ft.

* The minimum setback distance is measured between the proposed impervious area (excluding driveway access) and/or stormwater control/structure discharge point to the downslope property boundary. In lieu of meeting the minimum distance criteria, the applicant may provide documentation from a Registered Professional Engineer in the Commonwealth of Pennsylvania that the increased flows from the site leaves the site in the same manner as the pre-development condition, and that there will be no adverse affects to properties along the path of flow(s), or that the increased flow(s) will reach a natural watercourse or an existing stormwater management structure before adversely affecting any property along the path of the flow(s).

B. The municipality, upon request by the applicant, may grant an exemption from the provisions of this Ordinance for a project qualifying under Section 105.A. If an exemption is granted, the municipality shall require the developer to pay a fee in an amount established by separate Resolution of the Board of Supervisors to the Municipal Stormwater Management Capital Fund.

Section 106. Repealer

Any ordinance or ordinance provision of the municipality inconsistent with any of the provisions of this ordinance is hereby repealed to the extent of the inconsistency only.

Section 107. Severability

Should any section or provision of this ordinance be declared invalid by a court of competent jurisdiction, such decision shall not affect the validity of any of the remaining provisions of this ordinance.

Section 108. Compatibility with Other Ordinance Requirements

Approvals issued pursuant to this ordinance do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance.

Section 109. Modifications

The Board of Supervisors may grant a modification of the requirements of one or more provisions of this Ordnance if the literal enforcement will exact undue hardship because of peculiar conditions pertaining to the land in question, provided that such modification will not be contrary to the public interest and that the purpose and intent of the Ordinance is observed.

ARTICLE II. DEFINITIONS

For the purposes of this chapter, certain terms and words used herein shall be interpreted as follows:

A. Words used in the present tense include the future tense; the singular number includes the plural, and the plural number includes the singular; words of masculine gender include feminine gender; and words of feminine gender include masculine gender.

B. The word "includes" or "including" shall not limit the term to the specific example but is intended to extend its meaning to all other instances of like kind and character.

C. The word "person' includes an individual, firm, association, organization, partnership, trust, company, corporation, or any other similar entity.

D. The words "shall" and "must" are mandatory; the words "may" and "should" are permissive.

E. The words "used" or "occupied" include the words "intended", "designed", "maintained", or "arranged to be used", "occupied" or "maintained".

Accelerated erosion The removal of the surface of the land through the combined action of man's activity and the natural processes of a rate greater than would occur because of the natural process alone.

Agricultural activities The work of producing crops and raising livestock including tillage, plowing, disking, harrowing, pasturing and installation of conservation measures. Construction of new buildings or impervious area is not considered an agricultural activity.

Alluvial soils (floodplain soils) Areas subject to periodic flooding and listed in the Soil Survey of Bucks and Philadelphia Counties, Pennsylvania, U.S. Department of Agricultural Soil Conservation Service as being "on, or in, the floodplain" or subject to flooding. The following soil types are alluvial and/or floodplain soils:

Alluvial land
Alton gravely load, flooded
Bowmansville silt loam
Hatboro silt loam
Marsh
Pope loam
Rowland silt loam

Alteration As applied to land, a change in topography as a result of the moving of soil and rock from one location or position to another; also the changing of surface conditions by causing the surface to be more or less impervious; land disturbance.

Applicant A landowner or developer who has filed an application for approval to engage in any Regulated Activities as defined in Section 104 of this Ordinance.

BMP (Best Management Practice) Stormwater structures, facilities and techniques to maintain or improve the water quality of surface runoff.

Channel erosion The widening, deepening, and headward cutting of channels and waterways, due to erosion caused by moderate to large floods.

Cistern An underground reservoir or tank for storing rainwater.

Conservation District Bucks Conservation District.

County Bucks County

Culvert A pipe, conduit, or similar structure including appurtenant works which conveys surface water under or through an embankment or fill.

Dam An artificial barrier, together with its appurtenant works, constructed for the purpose of impounding or storing water or another fluid or semifluid, or a refuse bank, fill or structure for highway, railroad, or other purposes which does or may impound water or another fluid or semifluid.

Design storm The magnitude and temporal distribution of precipitation from a storm event measured in probability of occurrence (e.g. 50-year storm) and duration (e.g. 24-hours), used in the design and evaluation of stormwater management systems.

Designee The agent of the governing body involved with the administration, review, or enforcement of any provisions of this ordinance by contract or memorandum of understanding.

Detention basin An impoundment structure designed to manage stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

Detention district Those subareas in which some type of detention is required to meet the plan requirements and goals of Act 167.

Developer A person, partnership, association, corporation, or other entity, or any responsible person therein or agent thereof, that undertakes any regulated activity of this Ordinance.

Development Any man-made change to improved or unimproved real estate including, but not limited to, the construction or placement of buildings or other structures, mobile homes, streets and other paving, utilities, mining, dredging, filling, grading, excavation, or drilling operations, and the subdivision of land.

Development plan The provisions for development including a planned residential development, a plat of subdivision, all covenants relating to use, location and bulk of buildings and other structures, intensity of use or density of development, streets, ways and parking facilities, common open space and public facilities. The phrase "provisions of development plan" when used in this Ordinance shall mean the written and graphic materials referred to in this definition.

Development site The specific tract of land for which a regulated activity is proposed.

Downslope property line That portion of the property line of the lot, tract, or parcels of land being developed located such that all overland or pipe flow from the site would be directed toward it.

Downstream hydraulic capacity analysis Any downstream capacity hydraulic analysis conducted in accordance with this ordinance shall use the following criteria for determining adequacy for accepting increased peak flow rates:

1. Natural or man-made channels or swales must be able to convey the increased rate of runoff associated with a 2-year return period event within their banks at velocities consistent with protection of the channels from erosion. Acceptable velocities shall be based upon criteria included in the DEP Erosion and Sediment Pollution Control Program Manual.

2. Natural or man-made channels or swales must be able to convey the increased 25-year return period rate of runoff without creating any hazard to persons or property.

3. Culverts, bridges, storm sewers or any other facilities which must pass or convey flows from the tributary area must be designed in accordance with DEP, Chapter 105 regulations (if applicable) and, at a minimum, pass the increased 25-year return period rate of runoff.

4. No new channels or conveyance facilities shall be authorized by this language.

Drainage conveyance facility A stormwater management facility designed to transmit stormwater runoff which shall include streams, channels, swales, pipes, conduits, culverts, storm sewers, etc.

Drainage easement A right granted by a landowner to a grantee, allowing the use of private land for stormwater management purposes.

Earth disturbance Any activity including, but not limited to, construction, mining, timber harvesting, and grubbing which alters, disturbs, and exposes the existing land surface.

Engineer A licensed professional civil engineer registered by the Commonwealth of Pennsylvania.

Erosion The movement of soil particles by the action of water, wind, ice, or other natural forces.

Erosion and Sediment Pollution Control Plan A plan which is designed to minimize accelerated erosion and sedimentation.

Existing conditions The initial condition of a project site prior to the proposed construction. Farm field, disturbed earth, or undeveloped cover conditions of a site or portions of a site used for modeling purposes, shall be considered "meadow" unless the natural groundcover generates lower curve numbers or Rational "C" value, such as forested land. Existing man-made impervious surfaces shall be considered as "meadow" when developing "cover complex" calculations.

Flood A general but temporary condition of partial or complete inundation of normally dry land areas from the overflow of streams, rivers, and other waters of this commonwealth.

Floodplain Those areas of Hilltown Township which are subject to the one hundred year flood, as identified in the Flood Insurance Study (FIS) dated May 18, 1999, and the accompanying maps prepared for the Township by the Federal Emergency Management Agency (FEMA), or

most recent revision thereof; and also those areas along streams, ponds, or lakes not identified within the Flood Insurance Study which are inundated by the 100 year reoccurrence internal flood.

Floodway The channel of the watercourse and those portions of the adjoining floodplains that are reasonably required to carry and discharge the 100-year frequency flood. Unless otherwise specified, the boundary of the floodway is as indicated on maps and flood insurance studies provided by FEMA. In an area where no FEMA maps or studies have defined the boundary of the 100-year frequency floodway, it is assumed-absent evidence to the contrary-that the floodway extends from the stream to 50 feet from the top of the bank of the stream.

Forest Management/Timber Operations Planning and activities necessary for the management of forest land. These include timber inventory and preparation of forest management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, site preparation, and reforestation.

Freeboard A vertical distance between the elevation of the design high-water and the top of a dam, levee, tank, basin, or diversion ridge. The space is required as a safety margin in a pond or basin.

Grade The slope of a street, other public way, land area, drainage facility or pipe specified in percent.

Grassed waterway A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from cropland.

Groundwater recharge Replenishment of natural underground water supplies.

Hydric soils Soils that are categorized as poorly drained that can support hydrophytic plants, but may not do so in many cases. For the purpose of this Ordinance, hydric soils are general wetland indicator soils. (Refer Wetlands) The following soils, classified in the Soil Survey of Bucks and Philadelphia Counties, Pennsylvania, U.S. Department of Agricultural, Soil Conservation Service, July 1975, are hydric soils:

Bowmansville silt loam
Doylestown silt loam
Fallsington silt loam
Hatboro silt loam
Towhee silt loam
Towhee extremely stony silt loam

Impervious surface Impervious surfaces are those surfaces which do not absorb precipitation and surface water. All buildings, parking areas, driveways, roads, sidewalks, swimming pools, and any areas containing concrete, asphalt, packed stone, compacted soils, or other equivalent surfaces shall be considered impervious within this definition. In addition, other areas determined by the Township Engineer to be impervious within the meaning of this definition will be classified as impervious surfaces.

Impoundment A retention or detention basin designed to retain stormwater runoff and release it at a controlled rate.

Infiltration structures A structure designed to direct runoff into the ground (e.g. french drains, seepage pits, seepage trench, biofiltration swale).

Inlet A surface connection to a closed drain. A structure at the diversion end of a conduit. The upstream end of any structure through which water may flow.

Land development - Any of the following activities:

1. The improvement of one (1) or two (2) or more contiguous lots, tracts or parcels of land for any purpose involving:
   A. A group of two (2) or more residential or nonresidential buildings, whether purposed initially or cumulatively, or a single nonresidential building on a lot or lots regardless of the number of occupants or tenure; or
   B. The division or allocation of land or space, whether initially or cumulatively, between or among two (2) or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups or other features.
2. A subdivision of land.
3. "Land development" does not include development which involves:
   A. The conversion of an existing single family detached dwelling or single family semi-detached dwelling into not more than three (3) residential units, unless such units are intended to be a condominium;
   B. The addition of a residential accessory building, including farm building, not greater than 600 square feet in area on a lot or lots subordinate to an existing principal building; or
   C. The addition or conversion of buildings or rides within the confines of an enterprise which would be considered an amusement park. For the purposes of this subsection, an amusement park is defined as a tract or area used principally as a location for permanent amusement structures or rides. This exclusion shall not apply to newly acquired acreage by an amusement park until initial plans for the expanded area have been approved by the proper authorities.

Land/earth disturbance Any activity involving grading, tilling, digging, or filling of ground or stripping of vegetation or any other activity that causes an alteration to the natural condition of the land.

Main Stem (Main channel) Any stream segment or other runoff conveyance facility used as a reach in the watershed hydrologic model.

Manning Equation (Manning formula) A method for calculation of velocity of flow (e.g., feet per second) and flow rate (e.g., cubic feet per second) in open channels based upon channel shape, roughness, depth of flow and slope. "Open channels" may include closed conduits so long as the flow is not under pressure.

Municipal Engineer A professional engineer licensed as such in the Commonwealth of Pennsylvania and appointed by the Township pursuant to Article V of the Second Class Township Code.

Municipality Hilltown Township, Bucks County, Pennsylvania.

Nonpoint source pollution Pollution that enters a watery body from diffuse origins in the watershed and does not result from discernible, confined, or discrete conveyances.

NRCS Natural Resource Conservation Service (previously SCS).

Open channel A drainage element in which stormwater flows with an open surface. Open channels include, but shall not be limited to, natural and man-made drainageways, swales, streams, ditches, canals, and pipes flowing partly full.

Outfall Point where water flows from a conduit, stream, or drain.

Outlet Points of water disposal from a stream, river, lake, tidewater or artificial drain.

Parking lot storage Involves the use of impervious parking areas as temporary impoundments with controlled release rates during rainstorms.

Peak discharge The maximum rate of stormwater runoff from a specific storm event.

Penn State runoff model (calibrated) The computer-based hydrologic modeling technique adapted to the watershed for the Act 167 Plan. The model has been "calibrated" to reflect actual recorded flow values by adjoining key model input parameters.

Pipe A culvert, closed conduit, or similar structure (including appurtenances) that conveys stormwater.

Planning Commission The Planning Commission of Hilltown Township.

PMF (Probable Maximum Flood) The flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in any area. The PMF is derived from the probable maximum precipitation (PMP) as determined on the basis of data obtained from the National Oceanographic and Atmospheric Administration (NOAA).

Rational formula A rainfall-runoff relation used to estimate peak flow.

Recharge volume A calculated volume of stormwater runoff from impervious areas which is required to be infiltrated at a site and may be achieved through use of structural or non-structural BMPs.

Regulated activities Any activity to which this Ordinance is applicable pursuant to Section 104 of this Ordinance.

Release rate The percentage of predevelopment peak rate of runoff from a site or subarea to which the post development peak rate of runoff must be reduced to protect downstream areas.

Retention basin A basin designed to retain stormwater runoff so that a permanent pool is established.

Return period The average interval, in years, within which a storm event of a given magnitude can be expected to recur. For example, the 25-year return period rainfall would be expected to recur on the average once every 25 years.

Riser A vertical pipe extending from the bottom of a pond that is used to control the discharge rate from the pond for a specified design storm.

Rooftop detention Temporary ponding and gradual release of stormwater falling directly onto flat roof surfaces by incorporating controlled-flow roof drains into building designs.

Runoff Any part of precipitation that flows over the land surface.

Sediment basin A barrier, dam, or retention or detention basin located and designed to retain rock, sand, gravel, silt, or other material transported by water.

Sediment pollution The placement, discharge or any other introduction of sediment into the waters of the commonwealth occurring from the failure to design, construct, implement or maintain control measures and control facilities in accordance with the requirements of this ordinance.

Sedimentation The process by which mineral or organic matter is accumulated or deposited by the movement of water.

Seepage pit/seepage trench An area of excavated earth filled with loose stone or similar coarse material, into which surface water is directed for infiltration into the ground.

Sheet flow Runoff that flows over the ground surface as a thin, even layer, not concentrated in a channel.

Soil-cover complex method A method of runoff computation developed by the NRCS that is based on relating soil type and land use/cover to a runoff parameter called a Curve Number (CN).

Soil group, hydrologic A classification of soils by the NRCS into four runoff potential groups. The groups range from A soils, which are very permeable and produce little runoff, to D soils, which are not very permeable and produce much more runoff.

Spillway A depression in the embankment of a pond or basin which is used to pass peak discharge greater than the maximum design storm controlled by the pond.

Storage indication method A reservoir routing procedure based on solution of the continuity equation (inflow minus outflow equals the change in storage) with outflow defined as a function of storage volume and depth.

Storm frequency The number of times that a given storm event occurs or is exceeded on the average in a stated period of years. See "Return Period."

Storm sewer A system of pipes and/or open channels that convey intercepted runoff and stormwater from other sources, but excludes domestic sewage and industrial wastes.

Stormwater The total amount of precipitation reaching the ground surface.

Stormwater management facility Any structure, natural or man-made, that, due to its condition, design, or construction, conveys, stores, or otherwise affects stormwater runoff. Typical stormwater management facilities include, but are not limited to, detention and retention basins, open channels, storm sewers, pipes, and infiltration structures.

Stormwater management permit A permit issued by the township governing body after the drainage plan has been approved. Said permit is issued prior to or with the final township approval.

Stormwater management plan The plan for managing stormwater runoff within the Township adopted as required by the Act of October 4, 1978, P.L. 864, (Act 167).

Stormwater management site plan The plan prepared by the Developer or his engineer indicating how stormwater runoff will be managed at the particular site of interest according to this Ordinance.

Stream enclosure A bridge, culvert or other structure in excess of 100 feet in length upstream to downstream which encloses a regulated water of this commonwealth.

Subarea The smallest drainage unit of a watershed for which stormwater management criteria have been established in the stormwater management plan.

Subdivision The division or redivision of a lot, tract, or parcel of land by any means into two or more lots, tracts, parcels or other divisions of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, transfer of ownership, or building or lot development, provided, however, that the subdivision by lease of land for agricultural purposes into parcels of more than ten acres, not involving any new street or easement of access or any residential dwellings, shall be exempt.

Swale A low-lying stretch of land which gathers or carries surface water runoff.

Timber operations See Forest Management.

Time of concentration (Tc) The time for surface runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. This time is the combined total of overland flow time and flow time in pipes or channels, if any.

Volumetric Runoff Coefficient A variable indicative of stormwater runoff volume and dependent on the impervious coverage for a site.

Water Quality Volume A calculated volume of stormwater runoff from impervious areas which is required to be captured and treated at a site and may be achieved through use of structural or non-structural BMPs. Numerically, the water quality volume is a product of the volumetric runoff coefficient, the site area, and a depth of rainfall of 1".

Watercourse An intermittent or perennial stream of water, river, brook, creek, or swale identified on USGS or SCS mapping; and/or delineated Waters of the Commonwealth.

Waters of the Commonwealth Any and all rivers, streams, creeks, rivulets, ditches, watercourses, storm sewers, lakes, dammed water, wetlands, ponds, springs, and all other

bodies or channels of conveyance of surface and underground water, or parts thereof, whether natural or artificial, within or on the boundaries of this Commonwealth.

Wetland Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs, ferns, and similar areas.

Wetland Delineation The process by which wetland limits are determined. Wetlands must be delineated by a qualified specialist according to the 1989 Federal Manuals (as amended) for the Delineation of Jurisdictional Wetlands (whichever is greater) or according to any subsequent Federal or State regulation. Qualified specialist shall include those persons being Certified Professional Soil Scientists as registered with Registry of Certified Professionals in Agronomy Crops and Soils (ARCPACS); or as contained on consultant's list of Pennsylvania Association of Professional Soil Scientists (PAPSS); or as registered with National Society of Consulting Soil Scientists (NSCSS), or as certified by State and/or Federal certification programs; or by a qualified Biologist/Ecologist.

ARTICLE III. STORMWATER MANAGEMENT

Section 301. General Requirements

A. All regulated activities in the municipality which do not fall under the exemption criteria shown in Section 105 of this Ordinance shall submit a stormwater management plan consistent with this Ordinance to the municipality for review. These criteria shall apply to the total proposed development even if development is to take place in stages. Impervious surface shall include, but not be limited to, any roof, parking or driveway areas and any new streets and sidewalks. Any areas designed to be gravel or crushed stone shall be assumed to be impervious.

B. Stormwater drainage systems shall be provided in order to permit unimpeded flow along natural watercourses, except as modified by stormwater management facilities designed to encourage infiltration, groundwater recharge, and improved water quality.

C. Existing points of concentrated drainage that discharge onto adjacent property shall not be altered without written approval of the affected property owner(s) and shall be subject to any applicable discharge criteria specified in this ordinance.

D. Areas of existing sheet flow discharge shall be maintained wherever possible. If sheet flow is proposed to be concentrated and discharged onto adjacent property, the developer must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge, or otherwise prove that no erosion, sedimentation, flooding or other harm will result from the concentrated discharge; and submit written approval from the affected adjacent property owner(s).

E. Where a development site is traversed by watercourses, drainage easements shall be provided conforming to the line of such watercourses. The width of the easement shall be adequate to provide for the unimpeded flow of stormwater runoff from the 100 year storm event. Terms of the easement shall prohibit excavation, the placing of fill or structures, and any alterations that may adversely affect the flow of stormwater within any portion of the easement. Periodic maintenance of the easement shall be required by the landowner to ensure proper runoff conveyance.

F. When it can be shown that, due to topographic conditions, natural drainageways on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the line and grade of such natural drainageways. Work within natural drainageways shall be subject to approval by PA DEP through the Joint Permit Application process, or, where deemed appropriate by PA DEP, through the General Permit process.

G. Any stormwater management facilities regulated by this Ordinance that will be located in or adjacent to waters of the commonwealth or wetlands shall be subject to approval by PA DEP through the Joint Permit Application process, or, where deemed appropriate by PA DEP, the General Permit process. When there is a question whether wetlands may be involved, it is the responsibility of the Developer or his agent to show that the land in question cannot be classified as wetlands, otherwise approval to work in the area must be obtained from PA DEP.

H. Any stormwater management facilities regulated by this Ordinance that would be located on state highway rights-of-way, or discharge stormwater to facilities located within a state

highway right-of-way, shall be subject to approval by the Pennsylvania Department of Transportation (PADOT).

I. Minimizing site disturbance and impervious surface, and infiltrating stormwater runoff through seepage beds, infiltration trenches, etc. are encouraged, where soil conditions permit, to reduce the size or eliminate the need for retention/detention facilities.

J. Roof drains and sump pumps shall discharge to a natural watercourse, drainage swale, or stormwater easement. Roof drains and sump pumps shall not be connected to a storm sewer or street drainage structure unless designed as part of a stormwater management facility. In no case shall roof drains or sump pumps be connected to a sanitary sewer.

K. Whenever a watercourse is located within a development site, it shall remain open in the natural state and location and shall not be piped, impeded, or altered (except for road crossings). It is the responsibility of the developer to stabilize existing eroded stream/channel banks.

Section 302. Stormwater Management Districts – Peak Rate Control

A. Mapping of Stormwater Runoff Peak Rate Districts - In order to implement the provisions of this Ordinance, the Neshaminy Creek Watershed Stormwater Management Plan, Tohickon Creek Watershed Stormwater Management Plan, and Perkiomen Creek Watershed Stormwater Management Plan, Hilltown Township is hereby divided into Stormwater Runoff Peak Rate Districts consistent with the plan. The boundaries of the districts are indicated on the runoff peak rate district map that is available for inspection at the municipal building. A large-scale boundary map is included as Appendix D for reference.

B. The exact location of the Stormwater Runoff Peak Rate District boundary as it applies to a given development site shall be determined by mapping the boundaries using the 2-feet or 5-feet topographic contours provided as part of the stormwater management plan developed for the site in accordance with the Subdivision and Land Development Ordinance. The District boundaries as originally drawn coincide with topographic divides or, in certain instances, are drawn from the intersection of the watercourse or a potential flow obstruction to the topographic divide consistent with topography. The locations determined on the stormwater management plan shall be reviewed and verified by the municipal engineer.

C. Description of Tohickon Creek Watershed Stormwater Runoff Hydrologic Peak Rate Districts

1. Conditional No Detention Districts (Direct Discharge). Subareas identified on the official Sub-Basin Map available for inspection at the Township Office. Included in this district are 2, 3, 8-10, 18, 20, 21, 42, 43, 52, 54, 56, 57, 59, 61, 62, 67, 70-73, 76, 77, 81-83. These sub-areas may discharge post-development runoff without detention facilities without adversely affecting the total watershed peak flow. These areas are located adjacent to the Delaware River. Where the conveyance capabilities of the local receiving facilities are not adequate to safely transport the increased peak flows from undetained runoff a 100% release rate control is applied.

2. 100 Percent Release Rate District. Subareas included in this district are 4-7, 1-17, 19, 22-28, 31-34, 41, 44-51, 53, 55, 58, 60, 63, 64, 66, 68, 69, 74, 75, 84-98, 101, 109,

111 - 114, 116, 118, 119, 121-126. These subareas are not expected to incur a great deal of development growth due to location, topography, soils, or a combination of all three factors. Also, the location in the watershed of these sub-areas is of minor importance in supporting the overall watershed level runoff control. Therefore, these areas are allowed to release development runoff at a rate that does not exceed the existing rates of runoff.

3. 90 Percent Release Rate District. Subareas included in this district are 30, 35-40, 226. These areas are located in developing areas that have adequate drainage capacity in the receiving waterways. A slight amount of reduction is necessary to preserve this integrity of the receiving waterways and increase water quality of the receiving waterways, at the request of the local municipality.

4. 75 Percent Release Rate District. Subareas included in this district are 78-80, 99, 100, 102-108, 110, 115, 117, 120. Certain subareas require the control of stormwater runoff to a portion of the existing runoff equal to 75 percent. These areas are located in upper reaches of the watershed, specifically, areas around Quakertown Borough and Richlandtown Township which are projected to incur significant development impacts and have existing inadequate storm conveyance facilities. Some of these areas are expected to incur a relatively major increase in development pressure, while some areas may not see much development at all. In order to assure uniform watershed-level runoff control; however, the assignment of this release rate on a widespread basis will uniformly restrict the future runoff in a fashion that favors no particular sub-watershed.

D. For the purpose of implementing the provisions of the Neshaminy Creek Watershed Stormwater Management Plan, portions of the watershed have been divided into subareas. The delineation of subareas by number is shown on an official Sub-Basin Map which is available for inspection at the Township Office.

1. 100 Percent Release Rate District. Post-development runoff peak rate shall be controlled to 100% of the pre-development runoff peak rate within subareas 2.1, 2.2, 2.41, 3.11, and 3.12.

2. 80 Percent Release Rate District. Post-development runoff peak rate shall be controlled to 80% of the pre-development runoff peak rate within subarea 3.2.

3. 75 Percent Release Rate District. Post-development runoff peak rate shall be controlled to 75% of the pre-development runoff peak rate within subarea 2.3.

E. The Perkiomen Creek Watershed Stormwater Management Plan is currently being prepared in accordance with Act 167. Until adoption of a stormwater management plan for the Perkiomen Creek Watershed, the entire watershed located within Hilltown Township shall be a 100 percent release rate district.

Section 303. Stormwater Management Implementation Provisions (Performance Standards and Best Management Practices)

A. General Standards.

Post-development rates of runoff from any regulated activity shall not exceed the peak release rates of runoff prior to development for the design storms specified in Watershed Stormwater Management Plan, Section 302 of the Ordinance and using rainfall depths given in Table 3-1 below and Figure A-2, Appendix A of this Ordinance.

Table 3-1. Rainfall Depths

Frequency of Storm Event (years)	Rainfall Depth (inches)
1	2.4
2	3.1
5	3.7
10	4.5
25	5.5
50	7.0
100	7.5

(Source PennDOT, Intensity-Duration-Frequency Tables for Region 4)

B. Groundwater Recharge. Developed areas shall maintain groundwater recharge consistent with pre-development conditions, dependent on hydrologic soil groups and impervious cover. A minimum of one inch (1") of runoff shall be infiltrated unless the developer can prove the inability of the site to achieve this specific volume based on existing site conditions. The maximum available recharge shall be calculated based on utilizing the most capable recharge areas of the site. This volume of runoff is termed the "Recharge Volume" and is calculated in accordance with Section 305.K.

Design of the stormwater management facilities shall provide for groundwater recharge to compensate for the reduction in the percolation that occurs when the ground surface runoff characteristics have been altered. A detailed geologic evaluation of the project site shall be performed to determine the suitability of recharge facilities. The evaluation of the project site shall be performed by a qualified geologist and/or soil scientist, and shall at a minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability. Where pervious pavement is proposed for parking lots, recreational facilities, nondedicated streets, or other areas, pavement construction specifications shall be noted on the plan.

Whenever a stormwater facility will be located in an area underlain by limestone, a geological evaluation of the proposed location shall be conducted to determine susceptibility to sinkhole formations. The design of all facilities over limestone formations shall include measures to prevent groundwater contamination and, where necessary, sinkhole formation. Soils used for construction of basins shall have low-erodibility factors ("K" factors). The municipality may require the installation of an impermeable liner in detention basins. If the developer can prove through analysis that the site is in an area underlain by limestone, and such geologic conditions may result in sinkhole formations, then the site is exempt from recharge requirements. However, the site shall still be required to meet all other hydrologic and water quality management standards as found in this ordinance.

It shall be the developer's responsibility to verify if the site is underlain by limestone. The following note shall be attached to all Stormwater Management Site plans and signed by the developer's engineer/surveyor/landscape architect/architect "I, _____ certify that the proposed detention basin (circle one) is/is not underlain by limestone."

C. Water Quality. Developed areas will provide adequate storage and treatment facilities necessary to capture and treat the Water Quality Volume (WQ_v) consistent with Articles 3 and 4 of this ordinance. The "Water Quality Volume" is calculated in accordance with

Section 305.J. The Recharge Volume may be a component of the Water Quality Volume. If the Recharge Volume is less than the Water Quality Volume, the remaining Water Quality Volume may be captured and treated by methods other than recharge/infiltration BMPs.

D. District Boundaries - The boundaries of the Stormwater Management Districts are shown on an official map, which is available for inspection at the municipal office. A copy of the official map at a reduced scale is included in the Appendix D of this Ordinance. The exact location of Stormwater Management District boundaries as they apply to a given development site shall be determined by mapping the boundaries using topographic contours at an appropriate level of detail, but in no case less than 2 feet intervals (or 5 feet intervals as applicable). This information shall be provided as part of the Stormwater Management Plan.

E. Sites Located in More Than One District - For a proposed development site located within two or more release category subareas, the peak discharge rate from any subarea shall be the pre-development peak discharge for that subarea multiplied by the applicable release rate. The calculated peak discharges shall apply regardless of whether the grading plan changes the drainage area by subarea.

F. Off-Site Areas - Off-site areas that drain through a proposed development site are not subject to release rate criteria when determining allowable peak runoff rates or volume reduction. However, on-site drainage facilities shall be designed to safely convey off-site flows through the development site.

G. Site Areas - Where the site area to be impacted by a proposed development activity differs significantly from the total site area as determined by the municipality, the municipality may, but is not required to, permit only the proposed impact area to be subject to the release rate criteria.

H. Stormwater Conveyance Corridor Protection (Riparian Corridor Preservation and Vegetation) – Runoff from developed areas of the site, including but not limited to areas of impervious surface, shall be managed through a series of riparian corridor vegetation facilities whenever possible. This will be accomplished in a manner satisfactory to the municipality, utilizing the "Pennsylvania Handbook of Best Management Practices for Developing Areas", 1998, Riparian Forested Buffer, and the priority goal of the riparian vegetation will be the reduction of thermal impacts on stormwater runoff associated with impervious areas, with a secondary goal being the protection of capacity of existing stormwater conveyance channels. These goals will be achieved through the use of design criteria in Section 304.P of this Ordinance, and shall be in addition to any other municipal ordinance provisions.

I. Regional Detention Alternatives – For certain areas within the study area, it may be more cost-effective to provide one control facility for more than one development site than to provide an individual control facility for each development site. The initiative and funding for any regional runoff control alternatives are the responsibility of prospective developers. The design of any regional control basins must incorporate reasonable development of the entire upstream watershed. The peak outflow of a regional basin would be determined on a case-by-case basis using the hydrologic model of the watershed consistent with protection of the downstream watershed areas. "Hydrologic model" refers to the calibrated model as developed for the stormwater management plan.

J. "Downstream Hydraulic Capacity Analysis"-Any downstream capacity hydraulic analysis conducted in accordance with this ordinance shall use the following criteria for determining adequacy for accepting increased peak flow rates:

1. Natural or man-made channels or swales must be able to convey the increased runoff associated with a 2-year return period event within their banks at velocities consistent with protection of the channels from erosion. Acceptable velocities shall be based upon criteria included in the DEP *Erosion and Sediment Pollution Control Program Manual.*

2. Natural or man-made channels or swales must be able to convey the increased 25-year return period runoff without creating any hazard to persons or property.

3. Culverts, bridges, storm sewers or any other facilities which must pass or convey flows from the tributary area must be designed in accordance with DEP, Chapter 105 regulations (if applicable) and, at a minimum, pass the increased 25-year return period runoff.

Section 304. Design Criteria for Stormwater Management Facilities and Best Management Practices

A. Increased stormwater runoff which may result from Regulated Activities listed in Section 104 shall be controlled by permanent stormwater runoff control measures that will provide the required standards within Article III. The methods of stormwater control or Best Management Practices (BMPs) which may be used to meet the required standards are described in this Ordinance and are the preferred methods of controlling stormwater runoff. Additional design criteria are included in these descriptions. The choice of BMPs is not limited to the ones appearing in this Ordinance, however, any selected BMP must meet or exceed the runoff peak rate requirements of this Ordinance for the applicable Hydrologic District.

B. Any stormwater facility located on state highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation.

C. Any stormwater management facility designed to store runoff and requiring a berm or earthen embankment required or regulated by this Ordinance shall be designed to provide an emergency spillway to handle flow up to and including the 100-year post-development conditions. The height of embankment must be set as to provide a minimum 1.0 foot of freeboard above the maximum pool elevation computed when the facility functions for the 100-year post-development inflow.

D. Emergency spillways discharging over embankment fill shall be constructed of reinforced concrete checker blocks to protect the berm against erosion. The checker block lining shall extend to the toe of the fill slope on the outside of the berm, and shall extend to an elevation three (3) feet below the spillway crest on the inside of the berm.

E. Vegetated spillways may be utilized for spillways constructed entirely on undisturbed ground (i.e. not discharging over fill) if the designer can demonstrate that flow velocities through the spillways will not cause erosion of the spillway. A dense cover of vegetation shall be rapidly established in such spillways by sodding or seeding with a geotextile anchor. Such a vegetated spillway must be stabilized before runoff is directed to the basin.

F. Should any stormwater management facility require a dam safety permit under PA DEP Chapter 105, the facility shall be designed in accordance with Chapter 105 and meet the regulations of Chapter 105 concerning dam safety which may be required to pass storms larger than 100-year event.

G. Stormwater management facility outlet piping shall be Class III reinforced O-ring concrete pipe. A minimum of one (1) concrete anti-seep collar shall be required. Pre-cast collars shall have a minimum thickness of eight (8) inches; field poured collars shall have a minimum thickness of twelve (12) inches. Collars may not be installed within two (2) feet of pipe joints. Collars must be designed to project a minimum of two (2) feet around the perimeter of the pipe. Maximum collar spacing is fourteen (14) times the design projection around the perimeter.

H. Berms shall be constructed in accordance with requirements specified in Appendix "A".

I. No stone gabion baskets may be used in the construction of stormwater management facilities.

J. Retention/detention basins:

1. Pipe outlet shall permit complete drainage of all detained water, unless the stormwater management facility is designed as a retention basin/pond or provides for stormwater renovation with constructed wetlands.

2. When a detention basin is not designed as a stormwater management constructed wetland, the stormwater management facility shall be planted with low maintenance grass or substitute satisfactory to the Township.

3. All detention basin bottoms intended to be maintained as lawn (i.e. recreational fields) shall be designed with a minimum grade of 2%. As an alternative, the detention basin may be designed with a minimum grade of 1% with underdrains to ensure complete drainage.

4. To minimize the visual impact of detention basins, the detention basin shall be designed to avoid the need for safety fencing. To meet this requirement, basins shall be designed to the following specifications:

   a. Maximum depth of detained runoff shall be 24 inches for a 2 year or 10 year storm event.

   b. Maximum depth of detained runoff shall be 36 inches for a 100 year storm event.

   c. Interior slopes shall not be steeper than a ratio of 4:1 horizontal to vertical.

   d. Ponded water shall never exceed a depth of 24 inches for more than four hours.

   Depths and slopes may be exceeded by permission of the Township on a case-by-case basis if lot runoff, topography and/or existing downsteam systems make the

required pond area unreasonably large. In such case, fence and landscape screens will be required.

5. An access ramp of 10:1, 10 feet wide, shall be provided to allow maintenance equipment to reach the basin floor. The ramp shall coincide with the required gate if fencing is needed.

6. When required by the Township, fencing shall provide a suitable barrier at least four (4) feet in height of material approved by the Township, such as split rail fencing with wire backing. Access to the basin shall be provided by a gate or gates having a total opening of at least ten (10) feet at such location(s) as to permit ready access to the detention basin with maintenance equipment.

7. Landscaping:

   a. The perimeter berms and embankments of retention/detention basins including wet ponds, and artificial wetland stormwater management facilities shall be designed to create a natural appearance and reduce future maintenance requirements. Landscaping shall include a mixture of native tall grasses and perennial plants, ground cover, shrubs, and trees to eliminate the necessity of periodic mowing.

   b. Artificial wetland basins shall be designed pursuant to requirements of the Pennsylvania Handbook of Best Management Practices for developing areas. Plant material and arrangement shall be subject to approval of the Township. (Refer Appendix C – Plant lists for Wetland Management)

   c. The perimeter of the retention/detention basin shall be landscaped with a mixture of deciduous trees, evergreens, and shrubs arranged in an informal manner. Retention basin (wet ponds) and artificial wetland basin landscaping shall be designed to create a "natural" appearance. Minimum plant material shall include the following per 100 linear feet of basin perimeter measured at the 100 year reoccurrence stormwater elevation:

      (1) Three (3) evergreen trees (minimum height 4 feet)

      (2) Two (2) deciduous trees (minimum caliper 2½ inches)

      (3) Five (5) shrubs (minimum height 3 feet)

      Retention/detention basin landscaping design is subject to approval by the municipality.

8. Retaining walls shall not be specified for use within the 100 year water surface elevation area of any detention/retention facility or as part of any embankment or cut slope that is appurtenant to the construction of a detention/retention facility.

9. The Developer shall provide written assurance, satisfactory to the Township, that the retention/detention basin will be properly maintained. Such assurances shall be in a form to act as a covenant that will run with the land, and shall provide Township maintenance at the cost of the landowner in case of default, and further provide for assessment of costs and penalties in case of default.

10. As an alternate to the above paragraph, the Township may, at their own option, assume responsibility of the basin and may accept dedication of the basin by the Developer. If the retention/detention basin is dedicated or offered to the Township for long term maintenance, the following regulations shall apply:

    a. The dedicated area shall include the entire ponded area for the 100 year storm event and the outside slope at the berm.

    b. The dedicated area shall not be considered part of the Open Space and Recreation Land required elsewhere in the Subdivision and Land Development Ordinance and Zoning Ordinance.

    c. If fencing is necessary, the basin design shall provide a level area (2% slope) eight feet in width on both the inside and outside of the fence, along the entire length of the fence for proper access by Township maintenance equipment. The total width of this generally level area shall be at least 16 feet.

    d. The Developer shall provide for the special financial burden the Township will be accepting if the Township accepts the detention basin maintenance. To help mitigate this future financial burden, the Developer shall contribute to the Township a cash payment in the amount of fifteen thousand ($15,000.00) dollars per acre, on a pro rata basis, for any detention/retention basin site or area dedicated to the Township and being accepted by the Township. The detention/retention basin site area is measured to the outside limit of grading necessary to construct the basin and basin berm. The minimum contribution for any basin, regardless of size, shall be $7,500.00. This requirement may be modified by a Resolution of the Township, from time to time, to reflect actual long term costs of detention basin maintenance in the Township.

K. Any facilities that constitute water obstructions (e.g., culverts, bridges, outfalls, or stream enclosures), and any work involving wetlands as directed in PA DEP Chapter 105 regulations (as amended or replaced from time to time by PA DEP), shall be designed in accordance with Chapter 105 and will require a permit from PA DEP. Any other drainage conveyance facility that doesn't fall under Chapter 105 regulations must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year design storm with a minimum 1.0 foot of freeboard measured below the lowest point along the top of the roadway. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm with a minimum 1.0-foot of freeboard measured below the lowest point along surface of the roadway. Any facility that constitutes a dam as defined in PA DEP chapter 105 regulations may require a permit under dam safety regulations. Any facility located within a PA DOT right of way must meet PA DOT minimum design standards and permit submission requirements.

L. Any drainage conveyance facility and/or channel that doesn't fall under Chapter 105 regulations, must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year design storm. Conveyance facilities to or exiting from stormwater management facilities shall be designed to convey the design flow to or from that structure. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm. Any facility located within a PA DOT right-of-way must meet PA DOT minimum design standards and permit submission requirements.

M. Adequate erosion protection shall be provided along all open channels, and at all points of discharge.

N. Except for drainage at roadway stream crossings, pipe or artificial swale discharge shall be set back 75 feet from a receiving waterway, and the pipe discharge shall be diffused or spread out to reduce and eliminate high-velocity discharges to the impacted ground surface. The conveyance mechanism shall minimize disturbance and velocity of discharge.

O. All infiltration devices and groundwater recharge facilities shall be designed to completely drain all water in three days subsequent to any storm event.

P. Riparian Corridor Restoration – Within all major subdivisions and non-residential land developments, from the top of watercourse bank, seventy-five (75) feet on either side of the watercourse, which contains wetlands and/or floodplain, shall be planted to establish a Zone 1 and Zone 2 buffer in accordance with the Pennsylvania Handbook of Best Management Practices for Developing Areas, 1998, Riparian Forested Buffer (refer Appendix B). Where existing vegetation on the site essentially duplicates buffer requirements, this provision shall not apply. Additionally, this requirement may be modified or waived by the Board of Supervisors where existing man-made improvements or agricultural operations to be retained encroach within the buffer area.

Q. All developments which create impervious surface shall provide capacity for and treatment of the "Water Quality Volume" and "Recharge Volume", unless exempt from applicability under Section 104.

R. Special requirements for areas falling within defined Exceptional Value and High-Quality Sub-Watersheds: The temperature and quality of water and streams that have been declared as exceptional value or high quality is to be maintained as defined in Chapter 93 Water Quality standards, Title 25 of Pennsylvania Department of Environmental Protection Rules and Regulations. Temperature sensitive BMPs and stormwater conveyance systems are to be used and designed with storage pool areas and supply outflow channels, and shaded with trees. This will require the modification of berms for permanent ponds. At a minimum, the southern half of pond shorelines shall be planted with shade or canopy trees within ten feet of the pond shoreline. In conjunction with this requirement, the maximum slope allowed on the berm area to be planted is 10 to 1 to lessen the de-stabilization of berm soils due to root growth.

S. Developers shall utilize BMPs to provide for additional water quality improvement and groundwater recharge. In evaluating potential stormwater BMPs, the order of preference is as follows:

1. infiltration BMPs
2. flow attenuation methods (e.g. vegetated open swales and natural depressions)
3. artificial wetlands, bioretention structures, and wetponds
4. minimum first flush detention or dual purpose detention (where appropriate)

Infiltration BMPs shall be utilized unless the applicant can demonstrate use of infiltration techniques is not feasible due to site conditions based upon site specific soil testing. Vegetated swales, wetlands or artificial wetlands and bioretention structures shall be utilized wherever possible if infiltration BMPs are deemed unfeasible. BMP techniques can

and should be used in conjunction with each other (e.g. vegetated swales with infiltration or retention facilities).

1. Infiltration Best Management Practices (BMPs) – Infiltration devices shall be selected based upon suitability of soils and site conditions. Soil infiltration tests shall be performed on all sites to determine suitability of the site for infiltration BMPs. Testing shall include evaluation of selected soil horizons by soil probes, deep pits and/or percolation measurements. The soil infiltration rate of discharge from the infiltration area being used in the proposed design shall be based on these measurements. Infiltration BMPs shall be designed in accordance with the design criteria and specifications in Section 5 of the *Pennsylvania Handbook of Best Management Practices for Developing Areas* (1998) and shall meet the following minimum requirements:

    a. Infiltration BMPs intended to receive runoff from residential uses shall be constructed on soils which have the following characteristics:

        (1) A minimum depth of 48 inches between the intended bottom of the facility and the seasonal high water table and/or bedrock (limiting zones). The 48-inch minimum depth to a limiting zone requirement may be reduced to 24 inches as long as the soil has a cation exchange capacity (CEC) of greater than ten and/or does not have a sandy loam or loam sand texture.

        (2) Infiltration rate and percolation rate of greater than 0.2 inches/hour.

    b. Infiltration BMPs intended to receive runoff from non-residential uses shall be constructed on soils that have the following characteristics:

        (1) A minimum depth of 48 inches between the intended bottom of the facility and the seasonal high water table and/or bedrock (limiting zones),

        (2) Infiltration rate and percolation rate of greater than 0.2 inches/hour.

    c. Infiltration BMPs intended to receive rooftop runoff shall be constructed on soils that have a minimum depth of 24 inches between the intended bottom of the facility and the seasonal high water table and/or bedrock (limiting zones) and have an infiltration rate and percolation rate of greater than 0.2 inches/hour. Appropriate measures such as leaf traps and cleanouts shall be required to prevent clogging by vegetation.

    d. Where direct discharge is permitted under the requirements of Section 302, infiltration BMPs shall be designed to provide adequate storage to accommodate the post-development first flush design storm (1 year 24 storm) volume with outlet and overflow controls to convey runoff larger than the first flush design storm volume safely to a natural outfall.

    e. In areas where runoff release rates are specified under the requirements of Section 302, regardless of the specified release rate percentage, if infiltration BMPs are intended, they shall be designed to, as a minimum:

(1) Provide adequate storage to accommodate the volume of runoff calculated as the difference between the pre-development runoff volume and post-development runoff volume based on the 100 year design storm.

(2) Control the post-development peak rate of runoff to the pre-development peak rate of runoff for all design storms identified in Section 303.A.2. of this Ordinance.

(3) Provide an overflow or spillway that safely permits the passing of runoff greater than that occurring during the 100 year design storm.

2. Non-infiltration Facilities used as Best Management Practices (BMPs)

All facilities shall be designed in accordance to the design criteria and specifications in the *Pennsylvania Handbook of Best Management Practices for Developing Areas* (1998). This design shall be in particular coordination with Section 8, Descriptions of Selected Best Management Practices.

3. Artificial wetlands, wet ponds, and bioretention structures

a. Wet Pond BMPs shall meet the following requirements:

(1) Wet ponds shall be constructed on hydric or wet soils and/or soils which have an infiltration rate of less than 0.2 inches/hour.

(2) A minimum drainage area of five (5) acres shall be directed to the pond unless a source of recharge is utilized such as a natural spring or well.

(3) The length of the pond between the inflow and outlet points shall be maximized. In addition, an irregular shoreline shall be provided. By maximizing the flow length through the pond and providing an irregular shoreline, the greatest water quality benefit will be achieved by minimizing "short circuiting" of runoff flowing through the pond.

(4) A shallow forebay shall be provided adjacent to all inflow areas. The forebay shall be planted as a marsh with emergent wetland vegetation. The forebay serves to enhance sediment trapping and pollutant removal, as well as concentrating accumulated sediment in an area where it can be readily removed.

(5) All wet ponds shall be designed with public safety as a primary concern - An aquatic safety bench shall be provided around the perimeter of the permanent pool. The depth of the bench shall be a maximum of one (1) foot for a width of at least three (3) feet. A 3:1 slope shall lead from the edge of the safety bench toward the deep water portion of the pond. At least 15 feet of 3:1 slope shall be provided from the edge of the safety bench. Slopes in the remainder of the pond below the permanent pool elevation shall be a maximum of 2:1.

(6) The perimeter slope above the permanent pool shall have a maximum slope of 4:1 for a distance of at least 20 feet. The remaining areas above the permanent pool shall have a maximum slope of 3:1.

(7) Wet ponds shall have a deep water zone to encourage gravity settling of suspended fines, and prevent stagnation and possible eutrophication.

(8) Wet ponds shall be capable of being substantially drained by gravity flow. Where possible, wet ponds shall be equipped with a manually operated – drain that can be secured against unauthorized operation.

(9) A planting plan shall be developed for the wet pond, showing all proposed aquatic, emergent, and upland plantings.

(10) Wet ponds shall be designed to discourage use by Canada geese. Techniques employed shall include the following:

(a) Elimination of straight shorelines, islands, and peninsulas;

(b) Placement of walking paths (where applicable) along the shoreline;

(c) Placement of grassed areas (i.e. playing fields) at least 450 feet from the water surface;

(d) Vegetative barriers;

(e) Rock barriers;

(f) Installation of tall trees within 10 feet of the water surface;

(g) Use of ground covers not palatable to Canada geese.

b. Artificial Wetland BMPs shall meet the following requirements:

(1) Artificial wetlands shall be constructed on hydric or wet soils and/or soils which have an infiltration rate of less than 0.2 inches/hour.

(2) Runoff entering artificial wetlands shall be filtered through a sediment removal device before entering the wetland.

(3) A planting plan shall be developed for the artificial wetland showing all proposed aquatic, emergent, and upland plantings. The planting plan shall be developed to provide a diversity of species resulting in a dense stand of wetland vegetation.

(4) At least 75% of the surface area of the wetland shall be developed as a shallow water emergent wetland, with a water depth of less than 12". The reminder shall be constructed as open water with depths between 2 feet and 4 feet.

4. Minimum first flush detention/dual purpose BMPs

a. Minimum first flush detention/dual purpose detention basin BMPs shall be designed to meet the following requirements:

(1) Post-development runoff from a "water quality storm" (a 1-year, 24-hour event) shall be released over a minimum period of 24 hours.

(2) Two stage basins shall be utilized where first flush detention will be employed for water quality and conventional detention used for peak rate control of storms exceeding the 1-year, 24-hour event.

(3) Two stage basins shall be constructed so that the lower part of the basin is graded to detain stormwater from the "water quality storm", and the remainder of the basin graded as a flat overbank area to provide storage only for the larger, less frequent storm events. The overbank area is encouraged to be developed as an active or passive recreational area.

(4) The area inundated by the "water quality storm" is encourage to be maintained as a wetland environment, which will increase the water quality benefits of the first flush/dual purpose detention basin, and will prevent the need for mowing of a frequently saturated area.

T. All stormwater control facility designs shall conform to the applicable standards and specifications of the following governmental and institutional agencies:

1. American Society of Testing and Materials (ASTM)
2. Asphalt Institute (AI)
3. Bucks Conservation District (BCD)
4. Federal Highway Administration (FHWA)
5. National Crushed Stone Association (NCSA)
6. National Sand and Gravel Association (NSGA)
7. Pennsylvania Department of Environmental Protection (PADEP)
8. Pennsylvania Department of Transportation (PADOT)
9. U.S. Department of Agriculture, Natural Resources Conservation Service, Pennsylvania (USDA, NRCS, PA)

U. If special geological hazards or soil conditions, such as carbonate derived soils, are identified on the site, the developer's professional engineer shall consider the effect of proposed stormwater management measures on these conditions. In such cases, the municipality shall require an in-depth report by a registered professional geologist.

V. The design of all stormwater management facilities shall incorporate sound engineering principles and practices. Guidelines established by the *Pennsylvania Handbook of Best Management Practices for Developing Areas* (1998) shall be utilized in determining stormwater management facility design except where specifically modified by this or other Municipal Ordinance. The Municipality shall reserve the right to disapprove any design that would result in the occupancy or continuation of an adverse hydrologic or hydraulic condition within the watershed.

Section 305. Calculation Methodology

Stormwater runoff from all development sites shall be calculated using either the rational method or a soil-cover-complex methodology.

A. Any stormwater runoff calculations involving drainage areas greater than 200 acres, including on- and off-site areas, shall use generally accepted calculation technique that is

based on the NRCS soil cover complex method. Table 3-2 summarizes acceptable computation methods. It is assumed that all methods will be selected by the design professional based on the individual limitations and suitability of each method for a particular site.

The municipality may approve the use of the Rational Method to estimate peak discharges from drainage areas that contain less than 200 acres.

Table 3-2. Acceptable Computation Methodologies For Stormwater Management Plans

METHOD	METHOD DEVELOPED BY	APPLICABILITY
TR-20 or commercial package based on TR-20	USDA - NRCS	When use of full model is desirable or necessary
TR-55 or commercial package based on TR-55	USDA - NRCS	Applicable for plans within the models limitations
HEC - 1	U.S. Army Corps of Engineers	When full model is desirable or necessary
PSRM	Penn state Univ.	When full model is desirable or, necessary
Rational Method or commercial package based on Rational Method	Emil Kuiching (1889)	For sites less than 200 acres When approved by the municipality
Other methods	Various	As approved by the municipal engineer

B. All calculations consistent with this Ordinance using the soil cover complex method shall use the appropriate design rainfall depths for the various return period storms presented in Table 3-1 of this ordinance. If a hydrologic computer model such as PSRM or HEC-1 is used for stormwater runoff calculations, then the duration of rainfall shall be 24 hours. The NRCS 'S' curve shown in Figure A-1, Appendix A of this Ordinance shall be used for the rainfall distribution.

C. For the purposes of predevelopment flow rate determination, farm field or disturbed earth pre-development cover conditions of a site or portions of a site, and existing man-made impervious surface shall be considered as "meadow" when developing "cover complex" calculations.

D. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times of concentration for overland flow and return periods from the Design Storm Curves from PA Department of Transportation Design Rainfall Curves (1986) (Figure A-2). Times of concentration for overland flow shall be calculated using the methodology presented in Chapter 3 of Urban Hydrology for Small Watersheds, NRCS, TR-55 (as amended or replaced from time to time by NRCS). Times of concentration for channel and pipe flow shall be computed using Manning's equation.

E. Runoff Curve Numbers (CN) for both existing and proposed conditions to be used in the soil cover complex method shall be obtained from Table A-2 in Appendix A of this Ordinance.

F. Runoff coefficients (c) for both existing and proposed conditions for use in the Rational method shall be obtained from Table A-3 in Appendix A of this Ordinance.

G. Where uniform flow is anticipated, the Manning equation shall be used for hydraulic computations, and to determine the capacity of open channels, pipes, and storm sewers. Values for Manning's roughness coefficient (n) shall be consistent with Table A-4 in Appendix A of this Ordinance.

Outlet structures for stormwater management facilities shall be designed to meet the performance standards of this Ordinance using any generally accepted hydraulic analysis technique or method.

H. The design of any stormwater management facilities intended to meet the performance standards of this Ordinance shall be verified by routing the design storm hydrograph through these facilities using the Storage Indication Method. For drainage areas greater than 20 acres in size, the design storm hydrograph shall be computed using a calculation method that produces a full hydrograph. The municipality may approve the use of any generally accepted full hydrograph approximation technique that shall use a total runoff volume that is consistent with the volume from a method that produces a full hydrograph.

I. The municipality has the authority to require that computed existing runoff rates be reconciled with field observations and conditions. If the design professional engineer can substantiate through actual physical calibration that more appropriate runoff and time-of-concentration values should be utilized at a particular site, then appropriate variations may be made upon review and recommendations of the Municipal Engineer. Calibration shall require detailed gauge and rainfall data for the particular site in question.

J. Calculations of Water Quality Volume: The Water Quality Volume (WQ_v) is the storage capacity needed to treat 90 percent of the average annual stormwater rainfall from the developed areas of the site. The following calculation is used to determine the storage volume, WQ_v, in acre-feet of storage:

$$WQ_v = \frac{(1.95)\,(R_v)\,(A)}{12}$$

WQ_v = Water Quality Volume
A = Area in acres (developed area)
$R_v = 0.05 + 0.009(I)$ where I is the percent impervious cover (example: I = 50 for 50 percent impervious cover)
1.95 = is a coefficient representing the 90 percent annual rainfall (PA Handbook of Best Management Practices for Developing Areas)

WQ_v shall be designed as part of a stormwater management facility which incorporates water quality BMPs as a primary benefit of using that facility, in accordance with design specifications contained in "Pennsylvania Handbook of Best Management Practices for Developing Areas", 1998.

K. Calculation of Recharge Volume: The Recharge Volume (Re_v) is the volume of stormwater runoff from a developed site which shall be required to maintain existing pre-development groundwater recharge at development sites. It may be part of the Water Quality volume, and is calculated on the basis of treatment and recharge by structural stormwater management practices, as follows:

$$Re_v = \frac{(S)\,(R_v)\,(A)}{12}$$

Re_v = Recharge Volume
A = Area in acres (developed area)
$R_v = 0.05 + 0.009(I)$ is the percent of impervious cover (example: I = 50 for 50 percent impervious cover)

S is the Soil Specific Recharge factor and varies according to soil type, as follows:

Hydrologic Soil Group	Soil Specific Recharge Factor (S)
A	0.38
B	0.26
C	0.14
D	0.07

Structural stormwater management facilities which provide treatment and recharge of the required Recharge Volume will be designed as part of stormwater management facility which incorporates groundwater recharge BMP's as a primary benefit of using that facility, in accordance with design specifications contained in "Pennsylvania Handbook of Best Management Practices for Developing Areas", 1998.

L. All stormwater runoff calculations/reports and design of stormwater management facilities shall be prepared by a registered Professional Engineer licensed in the Commonwealth of Pennsylvania.

Section 306. Standards During Land Disturbance

A. Whenever vegetation and topography are to be disturbed, such activity must be in conformance with Chapter 102, Title 25, Rules and Regulations, Part 1, Commonwealth of Pennsylvania, Department of Environmental Protection, Subpart C, protection of Natural Resources, Article II, Water Resources, Chapter 102, "Erosion Control," and in accordance with the Bucks Conservation District and the standards and specifications of the Municipality.

B. Additional erosion and sedimentation control design standards and criteria that must be applied where infiltration BMPs are proposed include the following:

1. Areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase, so as to maintain their maximum infiltration capacity.

2. Infiltration BMPs shall not be constructed nor receive runoff until the entire contributory drainage area to the infiltration BMP has received final stabilization.

C. Peak discharges and discharge volumes from the site shall comply with the appropriate sections above, with the following additions:

1. For purposes of calculating required detention storage during land disturbance, peak discharges and discharge volumes shall be calculated based upon the runoff coefficients for bare soils during the maximum period and extent of disturbance which shall be clearing, indicated on the development plan. Controls shall insure that the difference in volume and rate of peak discharges before disturbance and during shall not exceed those peak discharges and discharge volumes required in Section 303 of

this Ordinance. Detention storage during the period of land disturbance and prior to establishment of permanent cover may require additional facilities on a temporary basis. Such measures shall be located so as to preserve the natural soil infiltration capacities of the planned infiltration bed areas.

2. Wherever soils, topography, cut and fill or grading requirements, or other conditions suggest substantial erosion potential during land disturbance, the Township may require that the entire volume of all storms up to a 2-year storm from the disturbed areas be retained on site and that special sediment trapping facilities (such as check dams, etc.) be installed.

D. Areas of the site to remain undisturbed shall be protected from encroachment by construction equipment/vehicles to maintain the existing infiltration characteristics of the soil.

ARTICLE IV. STORMWATER MANAGEMENT PLAN REQUIREMENTS

Section 401. General Requirements

For any of the activities regulated by this Ordinance, the final approval of subdivision and/or land development plans, the issuance of any building or occupancy permit, or the commencement of any land disturbance activity may not proceed until the property owner or developer or his/her agent has received written approval of a stormwater management plan from the municipality.

Section 402. Stormwater Management Plan Contents

The stormwater management plan shall consist of all applicable calculations, maps, and plans. A note on the maps shall refer to the associated computations and erosion and sedimentation control plan by title and date. The cover sheet of the computations and erosion and sedimentation control plan shall refer to the associated maps by title and date. All stormwater management plan materials shall be submitted to the municipality in a format that is clear, concise, legible, neat, and well organized; otherwise, the stormwater management plan shall be disapproved and returned to the applicant.

The following items shall be included in the stormwater management plan:

A. A feasibility analysis that evaluates the potential application of infiltration, flow attenuation, bioretention, wetland, or wet pond BMPs must be submitted with the stormwater management plans required in Article IV for those developments not intending the use of such facilities. This analysis shall provide:

   1. A general assessment of the anticipated additional runoff based on the design storm and post-development condition and utilizing the calculation procedures required in Section 305;
   2. indication of drainage areas on the development site resulting in impervious, pervious, and rooftop runoff;
   3. indication of type of land use (residential, non-residential) generating the impervious surface runoff;
   4. delineation of soils on the site from the SCS, Soil Survey of Bucks and Philadelphia Counties and onsite soil study. Soil study shall be conducted by a soil scientist and shall include sufficient probes/deep holes to evaluate application of BMPs;
   5. indication of soils generally suitable for infiltration and/or wet pond/artificial wetland BMPs as shown in the table entitled: "General Soil Suitability for Infiltration, Wet Pond and Artificial Wetland Best Management Practices With Consideration to Runoff Point of Origin and Land Use Type", including specification of those soils requiring modifications;
   6. calculated acreage of suitable soils for infiltration BMPs and wet pond or artificial wetland BMPs and percentage of suitable soils based on total site acreage;
   7. calculated acreage of suitable soils for infiltration BMPs and wet pond or artificial wetland BMPs made unavailable due to proposed development layout and justification that alternative development layout which would reduce impact on suitable soil availability is unfeasible;

8. analysis of potential infiltration or wet pond or artificial wetland BMPs which could be implemented to manage the projected post-development runoff with consideration of suitable soil availability runoff point of and type of land use (items 2. and 3. above) and the general design standards and maintenance issues included in this Ordinance including an indication of how most post-development runoff can be managed by these BMPs (e.g. the entire post-development runoff or partial amount of runoff expressed as a percentage); and

9. rationale for the decision to not proceed with implementation of infiltration BMPs or wet pond or artificial wetland BMPs such as excessive cost of implementation, insufficient soil suitability, and development constraints.

The feasibility analysis must allow the municipality to review the general soil characteristics of a site and the proposed development for that site and determine if infiltration BMPs or wet pond or artificial wetland BMPs could have been more thoroughly pursued for use by the developer. The information required in the analysis is detailed enough to determine the potential applicability of these BMPs for a proposed development, but general enough not to force a developer into incurring excessive cost associated with conducting laborious field and/or laboratory soil testing for a site which ultimately may not be suitable for infiltration or wet pond or artificial wetland BMP implementation. However, with the requirements for conducting a feasibility analysis, developers will be aware that they are expected to use these BMPs wherever possible and are required to provide adequate justification if these BMPs are not to be implemented. Essentially, all developers will be conducting feasibility analysis since such analysis would become the preliminary step in evaluating the potential for implementation of these mandatory BMPs where possible. Developers for those sites that are determined to be generally suitable from these analysis (taking into consideration the areal extent of suitable soils necessary to accommodate an infiltration or wet pond or wetland BMP for the type and size of development proposed) are required to conduct the detailed soil testing and other feasibility testing required in other sections of this Ordinance which contain the description and additional design criteria of these BMPs.

B. A detailed geologic evaluation of the project site shall be performed to determine the suitability of recharge facilities. The evaluation shall be performed by a qualified geologist and/or soil scientist, and a minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability.

C. Whenever a stormwater management facility will be located in an area underlain by limestone, a geological evaluation of the proposed location shall be conducted to determine susceptibility to sinkhole formations. The design of all facilities over limestone formations shall include measures to prevent ground water contamination and, where necessary, sinkhole formation. Soils used for the construction of basins shall have low-erodibility factors ("K" factors). Installation of an impermeable liner shall be required in detention basins.

It shall be the developer's responsibility to verify if the site is underlain by limestone. The following note shall be attached to all stormwater management plans and signed and sealed by the developer's professional engineer "I, _____, certify that the proposed detention basin (circle one) is/is not underlain by limestone."

D. General

1. General description of project.

2. General description of permanent stormwater management techniques, including construction specifications of the materials to be used for stormwater management facilities.

3. Complete hydrologic, hydraulic, and structural computations for all stormwater management facilities.

E. Map(s) of the project area shall be submitted on 24-inch x 36-inch sheets and shall be prepared in a form that meets the requirements for recording at the offices of the Recorder of Deeds of Bucks County. The contents of the maps(s) shall include, but not be limited to:

1. The location of the project relative to highways, municipalities, or other identifiable landmarks.

2. Existing contours at intervals of 2 feet. In areas of steep slopes (greater than 25 percent), 5 feet contours may be used.

3. Existing streams, lakes, ponds, or other bodies of water within the project area.

4. Other physical features including flood hazard boundaries, sinkholes, streams, existing drainage courses, wetlands, areas of natural vegetation to be preserved, and the total extent of the upstream area draining through the site.

5. The locations of all existing and proposed utilities, sanitary sewers, and water lines located on the site and/or within 50 feet of property lines.

6. An overlay showing soil names and boundaries. This overlay shall include a table on the map showing the recharge capabilities of each soil represented onsite in inches per hour and describe their recharge or infiltration capabilities.

7. Proposed changes to the land surface and vegetative cover, including the type and amount of impervious area that would be added.

8. Proposed structures, roads, paved areas, and buildings. Where pervious pavement is proposed for parking lots, recreational facilities, non-dedicated streets, or other areas, pavement construction specifications shall be noted on the plan.

9. Final contours at intervals at 2 feet. In areas of steep slopes (greater than 25 percent), 5-feet contour intervals may be used.

10. The name of the development, the name and address of the owner of the property, and the name of the individual or firm preparing the plan.

11. The date of submission.

12. A graphic and written scale of one (1) inch equals no more than fifty (50) feet. For tracts of twenty (20) acres or more, the scale may be one (1) inch equals no more than one hundred (100) feet.

13. A North arrow.

14. The total tract boundary and size with distances marked to the nearest foot and bearings to the nearest degree.

15. Existing and proposed land use(s).

16. A key map showing all existing man-made features beyond the property boundary that may be affected by the project.

17. Horizontal and vertical profiles of all open channels, including hydraulic capacity.

18. Overland drainage paths.

19. A twenty-feet wide access easement around all stormwater management facilities that would provide ingress to and egress from a public right-of-way.

20. A note on the plan indicating the location and responsibility for maintenance of stormwater management facilities that would be located off-site. All off-site facilities shall meet the performance standards and design criteria specified in this Ordinance.

21. A construction detail of any improvements made to sinkholes and the location of all notes to be posted, as specified in this Ordinance.

22. An agreement executed between the landowner, and municipality acknowledging the stormwater management system to be a permanent fixture that can be altered or removed only after approval of a revised plan by the municipality.

23. The location of all erosion and sedimentation control facilities.

F. Supplemental Information

1. A written description of the following information shall be submitted.

   a) The overall stormwater management concept for the project.

   b) Stormwater runoff computations as specified in this Ordinance.

   c) Stormwater management techniques to be applied both during and after development.

   d) Expected project time schedule.

2. A soil erosion and sedimentation control plan, where applicable, including all reviews and approvals, as required by PADEP and/or Bucks Conservation District.

3. A geologic assessment of the effects of runoff on sinkholes as specified in this ordinance.

4. The effect of the project (in terms of runoff volume and peak flow) on adjacent properties and on any existing municipal stormwater collection system that may receive runoff from the project site.

5. A Declaration of Adequacy and Highway Occupancy Permit from the PADOT District Office when utilization of a PADOT storm drainage system is proposed.

G. Stormwater Management Facilities

1. All stormwater management facilities must be located on a plan and described in detail.

2. When groundwater recharge methods such as seepage pits, beds, or trenches are proposed, the locations of existing and proposed septic tank infiltration areas, and wells must be shown. A separation distance of no less than 20 feet shall be provided between any septic system and any facility used for stormwater management.

3. All calculations, assumptions, and criteria used in the design of the stormwater management facilities must be shown. If multiple facilities are proposed in conjunction with each other, such as infiltration Best Management Practices with vegetation based management practices , a summary narrative, shall be included describing any sequence and how the facilities are meant to function with each other to manage stormwater runoff.

Section 403. Plan Submission

For all activities regulated by this ordinance, the steps below shall be followed for submission. For any activities that require a PADEP joint permit application and regulated under Chapter 105 (Dam Safety and Waterway Management) or Chapter 106 (Floodplain Management) of PADEP's Rules and Regulations, require a PADOT highway occupancy permit, or require any other permit under applicable local, state, or federal regulations, the permit(s) shall be part of the plan.

A. The stormwater management plan shall be submitted by the developer as part of the Preliminary plan submission for the regulated activity.

B. A minimum of three (3) copies of the stormwater management plan shall be submitted.

C. Distribution of the stormwater management plan will be as follows:

1. One (1) copy to the municipality accompanied by the requisite municipal review fee, as specified in this Ordinance.
2. Two (2) copies to the Municipal Engineer.

Section 404. Stormwater Management Plan Review

A. The Municipal Engineer shall review the stormwater management plan for consistency with the adopted Watershed Act 167 Stormwater Management Plan and applicable municipal ordinances. The municipality shall require receipt of a complete plan, as specified in this Ordinance.

B. The Municipal Engineer shall review the stormwater management plan for any subdivision or land development against the Subdivision and Land Development Ordinance provisions not superseded by this Ordinance.

C. For activities regulated by this Ordinance, the Municipal Engineer shall notify the municipality in writing, within 45 calendar days of receipt, whether the stormwater management plan is consistent with the adopted Watershed Act 167 Stormwater Management Plan. A copy of the Municipal Engineer's review letter shall be forwarded to the developer.

D. Any disapproved stormwater management plans may be revised by the developer and resubmitted consistent with this Ordinance.

E. For regulated activities specified in Sections 104.C and 104.D of this Ordinance, the Municipal Engineer shall notify the Municipal Building Permit Officer in writing, within a time frame consistent with the Building Code and/or Subdivision and Land Development Ordinance, whether the stormwater management plan is consistent with the adopted Watershed Act 167 Stormwater Management Plan and forward a copy of the review letter to the developer. Any disapproved stormwater management plan may be revised by the developer and resubmitted consistent with this ordinance.

F. The municipality shall not approve any subdivision or land development for regulated activities specified in Sections 104.A and 104.B of this Ordinance if the stormwater

management plan has been found to be inconsistent with the adopted Watershed Act 167 Stormwater Management Plan. All required permits from PADEP must be obtained prior to, or as a requirement of, final approval.

G. The Municipal Building Permit Office shall not issue a building permit for any regulated activity specified in Section 104 of this Ordinance if the stormwater management plan has been found to be inconsistent with the *adopted Watershed Act 167* Stormwater Management Plan, as determined by the Municipal Engineer, or without considering the comments of the Municipal Engineer. All required permits from PADEP must be obtained prior to issuance of a building permit.

H. The developer shall be responsible for completing an "as-built survey" of all stormwater management facilities included in the approved stormwater management plan. The as-built survey and an explanation of any discrepancies with the design plans shall be submitted to the Municipal Engineer for review. In no case shall the municipality approve the as-built survey until the municipality receives a copy of an approved Declaration of Adequacy, Highway Occupancy Permit from the PADOT District Office, and any applicable permits from PADEP.

I. The municipality's approval of a stormwater management plan shall be valid for a period not to exceed two (2) years. If stormwater management facilities included in the approved stormwater management plan have not been constructed, or if an as-built survey of these facilities has not been approved within this 2-year time period, then the municipality may consider the stormwater management plan disapproved and may revoke any and all permits. Stormwater management plans that are considered disapproved by the municipality shall be resubmitted in accordance with Section 407 of this Ordinance.

Section 405. Modification of Plans

A modification to a submitted stormwater management plan for a development site that involves a change in stormwater management facilities or techniques, or that involves the relocation or redesign of stormwater management facilities, or that is necessary because soil or other conditions are not as stated on the stormwater management plan as determined by the Municipal Engineer, shall require a resubmission of the modified stormwater management plan consistent with Section 403 of this Ordinance and be subject to review as specified in Section 404 of this Ordinance.

A modification to an already approved or disapproved stormwater management plan shall be submitted to the Municipality, accompanied by the applicable review. A modification to a stormwater management plan for which a formal action has not been taken by the municipality shall be submitted to the municipality, accompanied by the applicable municipal review fee.

Section 406. Resubmission of Disapproved Stormwater Management Plans

A disapproved stormwater management plan may be resubmitted, with the revisions addressing the Municipal Engineer's concerns documented in writing, to the Municipal Engineer in accordance with Section 404 of this Ordinance and be subject to review as specified in Section 405 of this Ordinance. The applicable municipal review fee must accompany a resubmission of a disapproved stormwater management plan.

ARTICLE V. INSPECTIONS

Section 501. Schedule of Inspections

A. The Municipal Engineer or his assignee shall inspect all phases of the installation of the permanent stormwater management facilities.

B. During any stage of the work, if the Municipal Engineer determines that temporary or permanent erosion and sedimentation control or stormwater management facilities are not being installed in accordance with the approved stormwater management plan, the municipality shall revoke any existing permits until a revised stormwater management plan is submitted and approved, as specified in this Ordinance.

ARTICLE VI. FEES AND EXPENSES

Section 601. Stormwater Management Plan Review Fee

The Municipality shall establish a review fee schedule by Resolution of the governing body to defray review costs incurred by the municipality, any outside review agencies or entities necessary to review submitted plans, and the municipal engineer. The municipality shall periodically update the review fee schedule to ensure that review costs are adequately reimbursed. The applicant shall pay all fees.

Section 602. Expenses Covered by Fees

The fees required by this Ordinance shall, at a minimum, cover the following:

A. Administrative costs.

B. Review of the stormwater management plan by the municipality and the Municipal Engineer.

C. Site inspections by the municipal staff and/or Municipal Engineer.

D. Inspection of stormwater management facilities and stormwater management improvements during construction.

E. Final inspection upon completion of the stormwater management facilities and stormwater management improvements presented in the stormwater management plan.

F. Any additional work required to enforce any permit provisions regulated by this Ordinance, correct violations, and ensure proper completion of stipulated remedial actions.

ARTICLE VII. MAINTENANCE RESPONSIBILITY

Section 701. Performance Guarantee

The applicant shall provide a financial guarantee to the municipality for the timely installation and proper construction of all stormwater management controls as required by the approved stormwater management plan and this Ordinance equal to the full construction cost of the required controls plus construction contingency and construction inspection costs.

Section 702. Maintenance Responsibilities

A. The stormwater management plan for the development site shall contain an operation and maintenance plan prepared by the design engineer. The operation and maintenance plan shall outline required routine maintenance actions and schedules necessary to insure proper operation of the facility(ies).

B. The stormwater management plan for the development site shall establish responsibilities for the continuing operation and maintenance of all proposed stormwater control facilities, consistent with the following principles:

   1. If a development consists of structures or lots that are to be separately owned and in which streets, sewers, and other public improvements are to be dedicated to the municipality, stormwater control facilities may also be dedicated to and maintained by the municipality, if accepted by the municipality.

   2. If a development site is to be maintained in a single ownership or if sewers and other public improvements are to be privately owned and maintained, then the ownership and maintenance of stormwater control facilities shall be the responsibility of the owner or private management entity.

C. The governing body, upon recommendation of the Municipal Engineer, shall make the final determination on the continuing maintenance responsibilities prior to final approval of the stormwater management plan. The governing body reserves the right to accept the ownership and operating responsibility for any or all of the stormwater management controls.

Section 703. Maintenance Agreement for Privately Owned Stormwater Facilities

A. Prior to final approval of the stormwater management plan, the property owner shall sign and record a maintenance agreement covering all stormwater control facilities that are to be privately owned.

B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory maintenance of all facilities. The maintenance agreement shall be subject to the review and approval of the Municipal Solicitor and governing body.

Section 704. Municipal Stormwater Maintenance Fund

A. If stormwater facilities are accepted by the municipality for dedication, persons installing stormwater storage facilities shall be required to pay a specified amount to the Municipal Stormwater Maintenance Fund to defray costs of periodic inspections and maintenance

expenses. The amount of the deposit shall be determined by Resolution of the Board of Supervisors and as follows:

1. If the storage facility is to be owned and maintained by the municipality, the deposit shall cover the estimated costs for maintenance and inspections for ten (10) years. The municipal engineer will establish the estimated costs utilizing information submitted by the applicant.

2. The amount of the deposit to the fund shall be converted to present worth of the annual series values. The municipal engineer shall determine the present worth equivalents, which shall be subject to the approval of the municipal governing body.

B. If a storage facility is proposed that also serves as a recreation facility (e.g., ball field, pond), the municipality may, but is not required to, reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreation purpose.

ARTICLE VIII. ENFORCEMENT AND PENALTIES

Section 801. Right-of-Entry

Upon presentation of proper credentials, duly authorized representatives of the municipality may enter at reasonable times upon any property within the municipality to inspect the condition of the stormwater structures and facilities in regard to any aspect regulated by this Ordinance.

Section 802. Notification

In the event that a person fails to comply with the requirements of this Ordinance, or fails to conform to the requirements of any permit issued hereunder, the municipality shall provide written notification of the violation. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of these violations(s). Failure to comply within the time specified shall subject such person to the penalty provision of this Ordinance. All such penalties shall be deemed cumulative. In addition the municipality may pursue any and all other remedies. It shall be the responsibility of the owner of the real property on which any regulated activity is proposed to occur, is occurring, or has occurred, to comply with the terms and conditions of this Ordinance.

Section 803. Enforcement

The governing body is hereby authorized and directed to enforce all of the provisions of this Ordinance. All inspections regarding compliance with the stormwater management plan shall be the responsibility of the Municipal Engineer or other qualified persons designated by the municipality as directed by the Board of Supervisors.

A. A set of design plans approved by the municipality shall be on file at the site throughout the duration of the construction activity. Periodic inspections may be made by the municipality or designee during construction.

B. Adherence to approved plan

It shall be unlawful for any person, firm, or corporation to undertake any regulated activity under Section 104 on any property except as provided for in the approved stormwater management plan and pursuant to the requirements of this Ordinance. It shall be unlawful to alter or remove any control structure required by the stormwater management plan pursuant to this Ordinance or to allow the property to remain in a condition which does not conform to the approved stormwater management plan.

C. At the completion of the project, and as a prerequisite for the release of the performance guarantee, the owner or his representatives shall:

1. Provide a certification of completion from a professional engineer verifying that all permanent facilities have been constructed according to the plans and specifications and approved revisions thereto.
2. Provide one reproducible and two paper prints of as-built drawings.

D. After receipt of the certification by the municipality, a final inspection shall be conducted by the governing body or its designee to certify compliance with this Ordinance.

E. Prior to revocation or suspension of a permit, the governing body will schedule a hearing to discuss the non-compliance if there is no immediate danger to life, public health or property.

F. Suspension and revocation of permits

1. Any permit issued under this Ordinance may be suspended or revoked by the governing body for:

a) Noncompliance with, or failure to, implement any provision of the permit.

b) A violation of any provision of this Ordinance or any other applicable law, Ordinance, rule, or regulation relating to the project.

c) The creation of any condition or the commission of any act during construction or development which constitutes or creates a hazard or nuisance, pollution or which endangers the life or property of others, or as outlined in Article IX of this Ordinance.

2. A suspended permit shall be reinstated by the governing body when:

a) The Municipal Engineer or his designee has inspected and approved the corrections to the stormwater management and erosion and sediment pollution control measure(s), or the elimination of the hazard or nuisance, and/or;

b) The governing body is satisfied that the violation of the Ordinance, law, or rule and regulation has been corrected.

c) A permit that has been revoked by the governing body cannot be reinstated. The applicant may apply for a new permit under the procedures outlined in this Ordinance.

G. Occupancy Permit

An occupancy permit shall not be issued unless the certification of compliance pursuant to Section 803.D has been secured. The occupancy permit shall be required for each lot owner and/or developer for all subdivisions and land developments in the municipality.

Section 804. Public Nuisance

A. The violation of any provision of this Ordinance is hereby deemed a public nuisance.

B. Each day that a violation continues shall constitute a separate violation

Section 805. Penalties

A. Anyone violating the provisions of this Ordinance shall be guilty of a misdemeanor, and upon conviction shall be subject to a fine of not more than $1,000 for each violation, recoverable with costs, or imprisonment of not more than 10 days, or both. Each day that the violation continues shall be a separate offense.

B. In addition, the municipality, through its solicitor, may institute injunctive, mandamus or any other appropriate action or proceeding at law or in equity for the enforcement of this Ordinance. Any court of competent jurisdiction shall have the right to issue restraining orders, temporary or permanent injunctions, mandamus or other appropriate forms of remedy or relief.

Section 806. Appeals

A. Any person aggrieved by any action of the municipality or its designee, relevant the provisions of this Ordinance, may appeal to the Zoning Hearing Board within thirty (30) days of that action.

B. Any person aggrieved by any decision of the Zoning Hearing Board, relevant to the provisions of this Ordinance, may appeal to the County Court of Common Pleas in the county where the activity has taken place within thirty (30) days of the Zoning Hearing Board's decision.

ENACTED and ORDAINED at a regular meeting of the Hilltown Township Board of Supervisors on the 23rd day of June, 2003. This Ordinance shall take effect immediately.

Betty Snyder
Chairperson

Vice Chairperson

John S. Bender
Supervisor

ATTEST:

Manager

I hereby certify that the foregoing Ordinance was advertised in the [name of newspaper] Doylestown Intelligencer on June 6, 03, a newspaper of general circulation in the municipality and was duly enacted and approved as set forth at a regular meeting of the Hilltown Township Board of Supervisors held on June 23, 03.

Manager

APPENDIX A
STORMWATER MANAGEMENT DESIGN CRITERIA

FIGURE A-1.
NRCS (SCS) TYPE II RAINFALL DISTRIBUTION

Scaled SCS Type II Design Storm
by Gert Aron
Penn State University

The SCS Type II storm distribution is widely accepted for the construction of a design storm. A problem in the practical application of the distribution, however, is the steepness of the SCS curve, shown in Figure 1, which makes it difficult to read relative rainfall amounts at short time intervals.

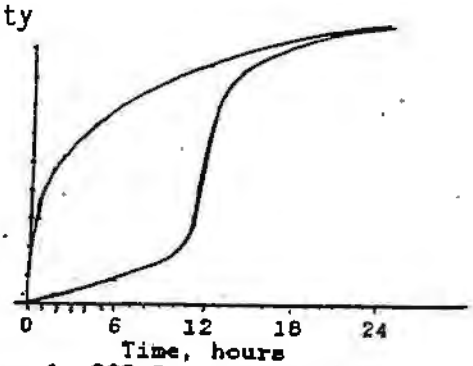


Fig. 1. SCS Storm Distribution

For the purpose of developing a systematic procedure to generate design storms of any desired time interval, equations were fitted to the SCS Type II storm distribution. A method for constructing a center peak storm is described below. To develop a useful equation, the storm distribution was rearranged to an early peaking pattern, starting with the steepest portion of the SCS curve and progressively decreasing in slope with time. The rearranged distribution is also shown in Figure 1, and can be expressed by the equations

$$P_t = 2.25\ P_{24}\ (t/24)^{0.46} \qquad \text{for } t < 1/2 \text{ hour} \qquad (1)$$

$$P_t = P_{24}\ (t/24)^{0.25} \qquad \text{for } t > 1/2 \text{ hour} \qquad (2)$$

where P = total precipitation in duration t
t = storm duration in hours

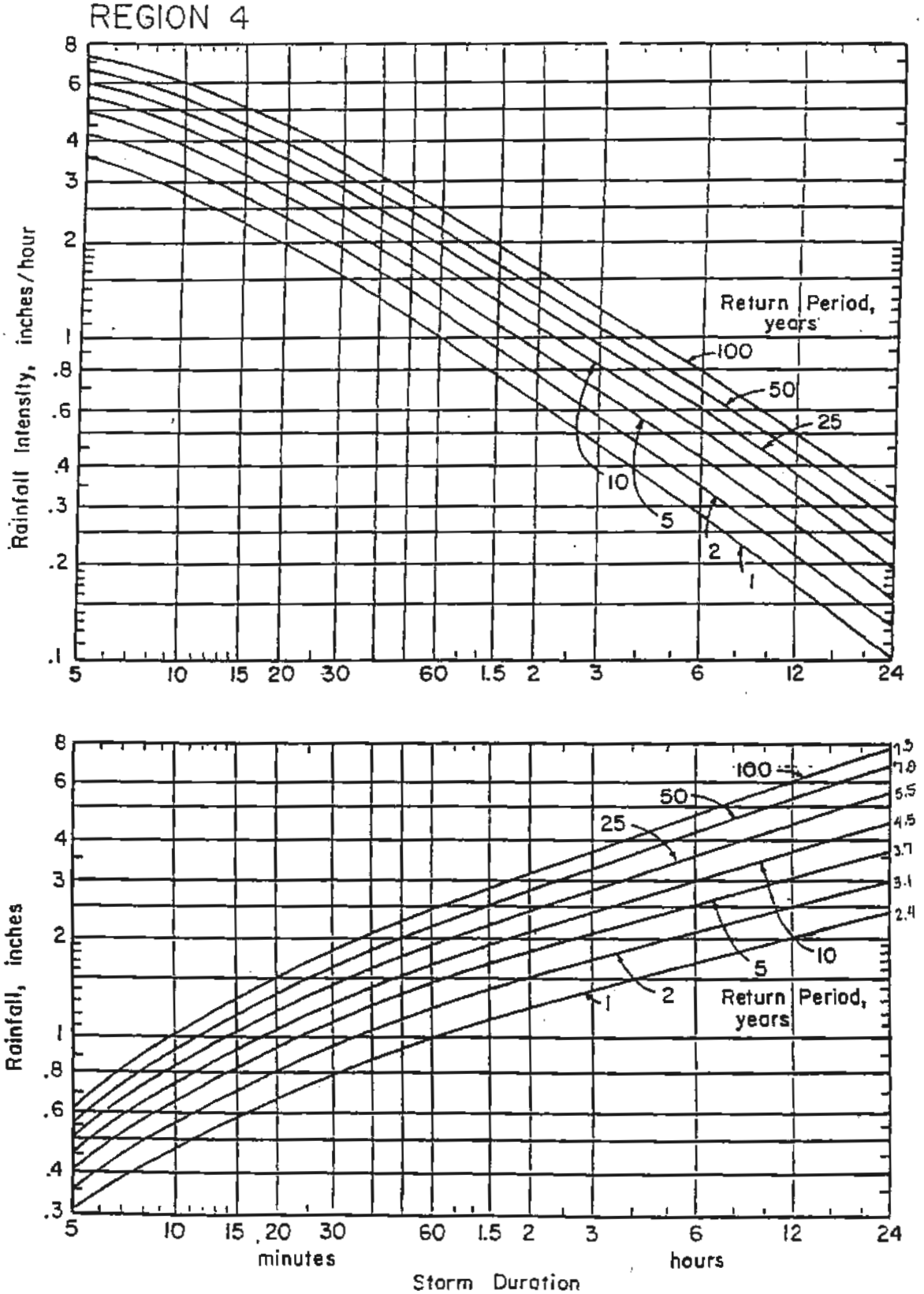
Design Storm Construction.

The design storm construction procedure is best described by an example, as follows:

A 25-year design storm of 2 hours duration, expressed in 15-minute intervals, is needed. From an appropriate source, like TP-40 or similar maps, the corresponding 24-hour rainfall amount is 4.0 inches. A table with five columns is required.

1) Col. 1 is time t in minutes or hours. In column 2 the relative rainfall P/P_{24} is shown as computed by eq.'s 1 or 2 for durations t.
2) In column 3, the relative amounts from column 2 are multiplied by 4.0, the 24-hr rainfall. These values represent the storm amounts from the steepest portions of the SCS curve, of duration t.
3) The rainfall increments between successive durations are computed from column 3 and listed in column 4. These values would constitute the successive rainfall increments, and thus the hyetograph for an early-peaking storm.
4) To generate a center-peaking, roughly symmetrical storm, the increments in column 4 are rearranged in column 5, placing the largest increment, of 1.10 inches in the 5th time interval, the second largest in the 4th time interval, the third-largest in the 6th time interval, the fourth-largest in the 3rd time interval, and so forth until a rainfall increment is assigned to each time interval.

FIGURE A-2.
PENNDOT STORM INTENSITY-DURATION-FREQUENCY CURVE, REGION 4



Rainfall intensity-duration-frequency curves for Region 4.

TABLE A-2.
RUNOFF CURVE NUMBERS (FROM NRCS (SCS) TR-55)

Runoff curve numbers for urban areas[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved: curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3]CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4]Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

TABLE A-2. CONTINUED

Runoff curve numbers for cultivated agricultural lands[1]

Cover description			Curve numbers for hydrologic soil group—			
Cover type	Treatment[2]	Hydrologic condition[3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T + CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T + CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1]Average runoff condition, and I_a = 0.2S.

[2]*Crop residue cover* applies only if residue is on at least 5% of the surface throughout the year.

[3]Hydrologic condition is based on combination of factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes in rotations, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

TABLE A-2. CONTINUED

Runoff curve numbers for other agricultural lands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1]Average runoff condition, and $I_a = 0.2S$.

[2]*Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

[3]*Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4]Actual curve number is less than 30; use CN = 30 for runoff computations.

[5]CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6]*Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

TABLE A-2. CONTINUED

Runoff curve numbers for arid and semiarid rangelands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1]Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.

[2]*Poor:* <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3]Curve numbers for group A have been developed only for desert shrub.

TABLE A-3.
RATIONAL RUNOFF COEFFICIENTS

Runoff Coefficients for the Rational Formula
By Hydrologic Soil Group and Overland Slope (%)

Land Use	A			B			C			D		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Cultivated Land	0.00[a] 0.14[b]	0.13 0.18	0.18 0.22	0.11 0.16	0.15 0.21	0.21 0.28	0.14 0.20	0.19 0.25	0.26 0.34	0.18 0.24	0.23 0.29	0.31 0.41
Pasture	0.12 0.15	0.20 0.25	0.30 0.37	0.18 0.23	0.28 0.34	0.37 0.45	0.24 0.30	0.34 0.42	0.44 0.52	0.30 0.37	0.40 0.50	0.50 0.62
Meadow	0.10 0.14	0.16 0.22	0.25 0.30	0.14 0.20	0.22 0.28	0.30 0.37	0.20 0.26	0.28 0.35	0.36 0.44	0.24 0.30	0.30 0.40	0.40 0.50
Forest	0.05 0.08	0.08 0.11	0.11 0.14	0.08 0.10	0.11 0.14	0.14 0.18	0.10 0.12	0.13 0.16	0.16 0.20	0.12 0.15	0.16 0.20	0.20 0.25
Residential Lot Size 1/8 Acre	0.25 0.33	0.28 0.37	0.31 0.40	0.27 0.35	0.30 0.39	0.35 0.44	0.30 0.38	0.33 0.42	0.38 0.49	0.33 0.41	0.36 0.45	0.42 0.54
Lot Size 1/4 Acre	0.22 0.30	0.26 0.34	0.29 0.37	0.24 0.33	0.29 0.37	0.33 0.42	0.27 0.36	0.31 0.40	0.36 0.47	0.30 0.38	0.34 0.42	0.40 0.52
Lot Size 1/3 Acre	0.19 0.28	0.23 0.32	0.26 0.35	0.22 0.30	0.26 0.35	0.30 0.39	0.25 0.33	0.29 0.38	0.34 0.45	0.28 0.36	0.32 0.40	0.39 0.50
Lot Size 1/2 Acre	0.16 0.25	0.20 0.29	0.24 0.32	0.19 0.26	0.23 0.32	0.28 0.36	0.22 0.31	0.27 0.35	0.32 0.42	0.26 0.34	0.30 0.38	0.37 0.48
Lot Size 1 Acre	0.14 0.22	0.19 0.26	0.22 0.29	0.17 0.24	0.21 0.28	0.26 0.34	0.20 0.28	0.25 0.32	0.31 0.40	0.24 0.31	0.29 0.35	0.35 0.46
Industrial	0.67 0.85	0.68 0.85	0.68 0.86	0.68 0.85	0.68 0.86	0.69 0.86	0.68 0.86	0.69 0.86	0.69 0.87	0.69 0.86	0.69 0.86	0.70 0.88
Commercial	0.71 0.88	0.71 0.88	0.72 0.89	0.71 0.89	0.72 0.89	0.72 0.89	0.72 0.89	0.72 0.89	0.72 0.90	0.72 0.89	0.72 0.89	0.72 0.90
Streets	0.70 0.76	0.71 0.77	0.72 0.79	0.71 0.80	0.72 0.82	0.74 0.84	0.72 0.84	0.73 0.85	0.76 0.89	0.73 0.89	0.75 0.91	0.78 0.95
Open Space	0.05 0.11	0.10 0.16	0.14 0.20	0.08 0.14	0.13 0.19	0.19 0.26	0.12 0.18	0.17 0.23	0.24 0.32	0.16 0.22	0.21 0.27	0.28 0.39
Parking	0.85 0.95	0.86 0.96	0.87 0.97	0.85 0.95	0.86 0.96	0.87 0.97	0.85 0.95	0.86 0.96	0.87 0.97	0.85 0.95	0.86 0.96	0.87 0.97

[a] Runoff coefficients for storm recurrence intervals less than 25 years.
[b] Runoff coefficients for storm recurrence intervals of 25 years or more.

Source: Rawls, W.J., S.L. Wong and R.H. McCuen, 1981, "Comparison of Urban Flood Frequency Procedures," Preliminary Draft, U.S. Department of Agriculture, Soil Conservation Service, Beltsville, MD.

TABLE A-4.
MANNING ROUGHNESS COEFFICIENTS

Values of n to Be Used with the Manning Equation

Surface	Best	Good	Fair	Bad
Uncoated cast-iron pipe	0.012	0.013	0.014	0.015
Coated cast-iron pipe	0.011	0.012*	0.013*	
Commercial wrought-iron pipe, black	0.012	0.013	0.014	0.015
Commercial wrought-iron pipe, galvanized	0.013	0.014	0.015	0.017
Smooth brass and glass pipe	0.009	0.010	0.011	0.013
Smooth lockbar and welded "OD" pipe	0.010	0.011*	0.013*	
Riveted and spiral steel pipe	0.013	0.015*	0.017*	
Vitrified sewer pipe	0.010 0.011	0.013*	0.015	0.017
Common clay drainage tile	0.011	0.012*	0.014*	0.017
Glazed brickwork	0.011	0.012	0.013*	0.015
Brick in cement mortar; brick sewers	0.012	0.013	0.015*	0.017
Neat cement surfaces	0.010	0.011	0.012	0.013
Cement mortar surfaces	0.011	0.012	0.013*	0.015
Concrete pipe	0.012	0.013	0.015*	0.016
Wood stave pipe	0.010	0.011	0.012	0.013
Plank Flumes:				
Planed	0.010	0.012*	0.013	0.014
Unplaned	0.011	0.013*	0.014	0.015
With battens	0.012	0.015*	0.016	
Concrete-lined channels	0.012	0.014*	0.016*	0.018
Cement-rubble surface	0.017	0.020	0.025	0.030
Dry-rubble surface	0.025	0.030	0.033	0.035
Dressed-ashlar surface	0.013	0.014	0.015	0.017
Semicircular metal flumes, smooth	0.011	0.012	0.013	0.015
Semicircular metal flumes, corrugated	0.0225	0.025	0.0275	0.030
Canals and Ditches:				
Earth, straight and uniform	0.017	0.020	0.0225*	0.025
Rock cuts, smooth and uniform	0.025	0.030	0.033*	0.035
Rock cuts, jagged and irregular	0.035	0.040	0.045	
Winding sluggish canals	0.0225	0.025*	0.0275	0.030
Dredged earth channels	0.025	0.0275*	0.030	0.033
Canals with rough stony beds, weeds on earth banks	0.025	0.030	0.035*	0.040
Earth bottom, rubble sides	0.028	0.030*	0.033*	0.035
Natural Stream Channels:				
(1) Clean, straight bank, full stage, no rifts or deep pools	0.025	0.0275	0.030	0.033
(2) Same as (1), but some weeds and stones	0.030	0.033	0.035	0.040
(3) Winding, some pools and shoals, clean	0.033	0.035	0.040	0.045
(4) Same as (3), lower stages, more ineffective slope and sections	0.040	0.045	0.050	0.055
(5) Same as (3), some weeds and stones	0.035	0.040	0.045	0.050
(6) Same as (4), stony sections	0.045	0.050	0.055	0.060
(7) Sluggish river reaches, rather weedy or with very deep pools	0.050	0.060	0.070	0.080
(8) Very weedy reaches	0.075	0.100	0.125	0.150

* Values commonly used in designing.

BASIN BERM CONSTRUCTION REQUIREMENTS

1. Site preparation – Areas under the embankment and any structural works shall be cleared, grubbed, and the topsoil stripped to remove the trees, vegetation, roots or other objectionable material. In order to facilitate clean-out and restoration, the pool area will be cleared of all brush and excess trees.

2. Cut off trench – A cut-off trench will be excavated along the centerline dam on earth fill embankments. The minimum depth shall be two feet. The cut-off trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be eight feet but wide enough to permit operation of compaction equipment. The side slopes shall be no steeper than 1:1. Compaction requirements shall be the same as those for the embankment. The trench shall be kept free from standing water during the backfilling operations.

3. Embankment – The fill material shall be taken from selected borrow areas. It shall be free of roots, woody vegetation, oversized stones, rocks or other objectionable material. Areas on which fill is to be placed shall be scarified prior to placement of fill.

   The fill material should contain sufficient moisture so that it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction.

   Fill material will be placed in 6 to 8 inch layers and shall be continuous over the entire length of the fill. Fill material must be compacted to a minimum of 95% of Modified Proctor Density as established by ASTM D-1557. Compaction testing by a certified soils engineer/geologist must be completed as directed by the Township Engineer to verify adequate compaction has been achieved.

APPENDIX B
RIPARIAN FORESTED BUFFER

APPENDIX B

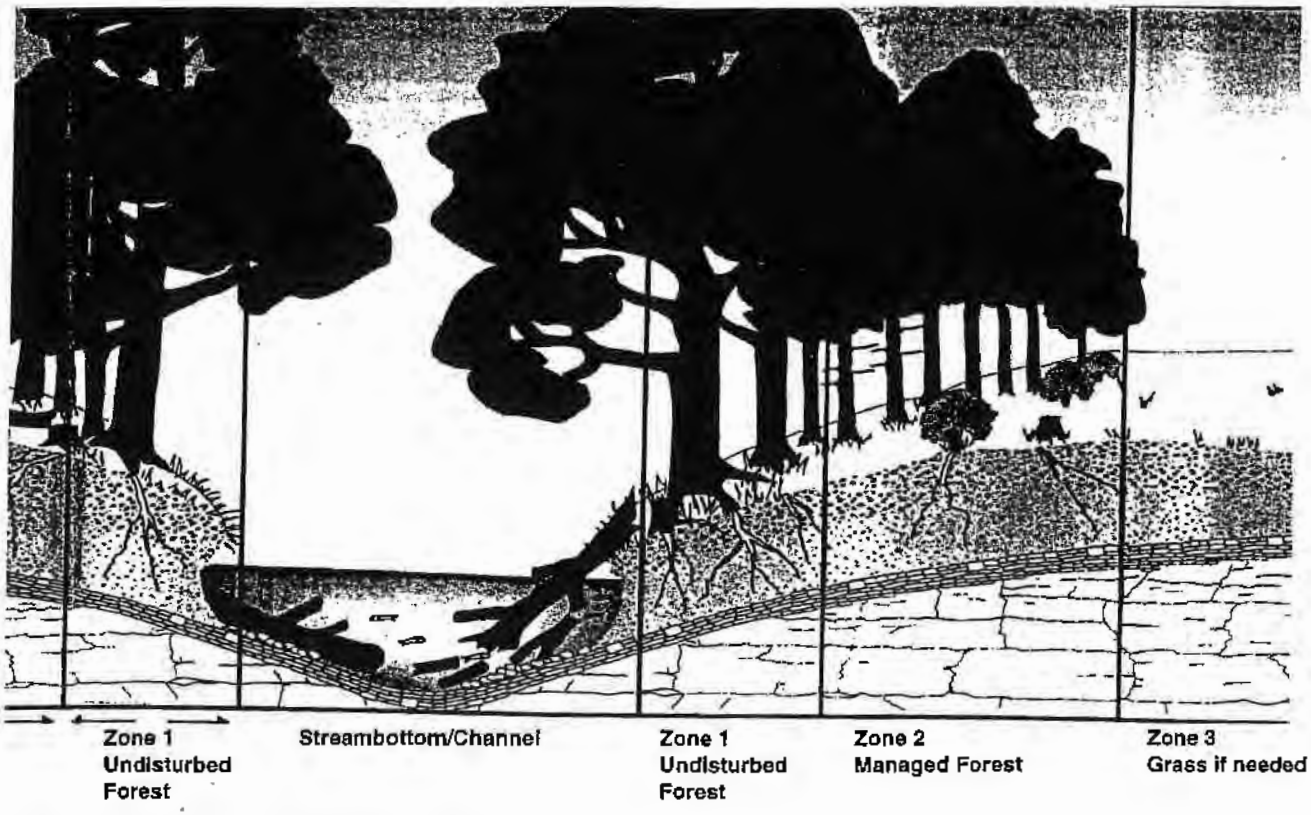


Figure 2. 3-Zone buffer for riparian forest buffer.

An accepted standard for riparian forest buffers is called the 3-zone buffer is illustrated in Figure 2 (USDA, NA-PR-07-90). The width of each of the zones may vary depending upon the size of the stream and its topographic setting. However, 85 feet is sufficient in most small and medium-sized streams to incorporate the functions of the three zones.

3-Zone Buffer

Zone 1 starts from the top of stream bank and typically is 15 feet wide, or wider. Vegetation in Zone 1 generally consists of trees and woody shrubs. Vegetation in the zone provides shade and detrital nutrients for aquatic organisms and stabilizes banks. Stabilization also may require additional techniques described in the STREAM BANK STABILIZATION BMP. Minimal disturbance is recommended for this area; however, vegetation structure must be maintained.

Zone 2 typically is 60 feet wide. The function of Zone 2 is to provide necessary contact time and material for buffering and filtering processes. Zone 2 cannot mitigate concentrated flow, therefore, for the buffer to be effective, only sheet or subsurface flow may reach this area. Vegetation in Zone 2 consists of trees and shrubs. Suitable nutrient filtering species are listed in Appendix H, *Plant Lists for Wetland Management.* The Pennsylvania State University's *The Agronomy Guide* should be consulted before establishing riparian forested buffers.

Zone 3 typically is 20 feet wide. The function of Zone 3 is to filter sediment, take up nutrients, and convert concentrated flow to sheet flow. Specifications for designing buffers in Zone 3 are discussed in the FILTER STRIP BMP.

APPENDIX C
PLANT LISTS FOR WETLAND MANAGEMENT

APPENDIX C

PLANT LISTS FOR WETLAND MANAGEMENT

Table C-1 References to Wetland Ecology and Habitat Information

Author/Year	Title	Description
Dennison and Berry, eds. (1993)	*Wetlands/ Guide to Science, Law, and Technology*	Regulatory definitions; general wetland ecology; types of wetlands; delineation; mitigation; risk assessment
Hammer (1992)	*Creating Freshwater Wetlands*	Handbook on types of wetlands, wetland structure and function, wetland creation, and operation and maintenance
Kadlec and Knight (1996)	*Treatment Wetlands*	Includes chapters on wetland ecology including water quality, soils, vegetation, and fauna
Majumdar et al. eds. (1989)	*Wetlands Ecology and Conservation: Emphasis in Pennsylvania*	Collected chapters on wetland classification, hydrology, surface water quality, plant and animal communities, assessment and restoration, and recreation
Marble (1992)	*A Guide to Wetland Functional Design*	Guidebook to designing wetlands for habitat creation, restoration, and mitigation; describes wetland hydrology, chemistry, sediment interactions, foodchain support functions, and design for wildlife habitat
Merritt (1994)	*Wetlands, Industry & Wildlife*	Handbook on creating and managing wetlands for wildlife habitat in the context of industrial development
Mitsch and Gosselink (1993)	*Wetlands*	Complete textbook covering all facets of wetland ecology; hydrology; biogeochemistry; biological adaptations; ecosystem-level processes; wetland types; wetland management
Niering (1985)	*Wetlands*	Audubon Society nature field guide to wetland ecology; types of wetlands; descriptions and photographs of wetland flora and fauna
Payne (1992)	*Techniques for Wildlife Habitat Management of Wetlands*	Guidebook to creation of wetlands with focus on creation of wildlife habitat

Table C-2 **Aquatic and Wetland Plants That Can Be Used in Constructed Wetlands.**

Plant Species	Common Name	Growth Form	Persistence	Growth/Spread Rate	Vegetative Growth Method	Spacing	Propagules	Habitat	Shade Tolerance	Wildlife Benefits	Water Regime	Salinity Tolerance
Acer negundo	Box elder	Tree	Perennial; deciduous	Fast; 4.5 to 6 m / 5 yrs			Container	Forested wetlands	Full sun	Songbirds; waterbirds; small mammals	Irregular to regular inundation or saturation	Fresh water; resistant to salt water
Acer rubrum	Red maple	Tree	Perennial; deciduous	Medium to fast; 5 to 7 m/ 10 yrs			Seed; whip; bare root	Fresh marsh; swamp; alluvial woods	Partial shade	Gamebirds; songbirds; browsers	Irregular to seasonally inundated or saturated	Fresh water; < 0.5 ppt
Acorus calamus	Sweet flag	Emergent; herbaceous	Perennial; nonpersistent	Moderate; 15 cm/yr	Rhizome	0.3 to 0.9 m O.C.	Rhizome; bare root plant	Fresh to brackish marshes	Partial shade	Waterfowl; muskrat	Regular to permanent inundation; < 15 cm	Fresh to brackish; < 10 ppt
Alnus serrulata	Smooth alder	Shrub	Perennial; deciduos	Rapid; 60 cm/yr			Container	Fresh marshes and swamps	Full sun	Songbirds; gamebirds; ducks; woodcock; blackbirds; beaver	Seasonal to regular inundation; up to 7 cm	Fresh water; < 0.5 ppt
Carex spp.	Sedges	Emergent; herbaceous	Perennial; nonpersistent	Slow to rapid	Rhizome	0.15 to 1.8 m O.C.	Seed; bare root plant	Fresh marshes; swamps; lake edges	Full shade to full sun	Rails; sparrows; snipe; songbirds; ducks; moose	Irregularly to permanently inundated; <015 cm	Fresh water; <0.5 ppt
Cepahlanthus occidentalis	Buttonbush	Shrub	Perennial; deciduous	Medium; 30 to 60 cm/yr			Seedling; bare rootplant	Fresh marshes; swamps; edge of ponds	Full shade to full sun	Ducks; deer; rails; blackbirds; muskrats; beaver	Irregular to permanent inundation; up to 90 cm	Fresh water; tolerates infrequent salt water
Ceratophyllum demersum	Coontail	Submerged aquatic	Perennial	Rapid	Fragmentation		Whole Plant	Lakes; Slow Streams		Ducks; coots; geese; grebes; swans; marshbirds; muskrats	Regular to permanent inundation; 0.3 to 1.5 m	Fresh water; <0.05 ppt
Cyperus esculentus	Chufa	Emergent herbaceous	Perrenial; nonpersistent	Rapid	Rhizome		Seed; tuber	Fresh marshes; wet meadows	Full sun	Waterfowl; songbirds; small mammals	Irregular to regular inundation; <0.3 m	Fresh water; <0.5 ppt
Eichhornia crassipes	Water hyacinth	Non-rooted floating aquatic	Perennial; nonpersistent	Rapid	Stolons		Whole plants	Fresh water ponds and sluggish streams	Full sun	Coots; cover for invertebrates and fish	Permanent inundation	Fresh water; < 0.5 ppt
Hydrocotyle umbellata	Water-pennywort	Emergent to floating; herbaceous	Perennial; nonpersistent	Rapid	Stolons or rhizomes		Bare root plant; whole plant	Shorelines; shallow marshes	Partial shade	Wildfowl; waterfowl	Regular to permanent inundation;<30 cm	Fresh water; <0.5 ppt
Iris versicolor	Blue flag	Emergent; herbaceous	Perennial; nonpersistent	Slow; <60 cm/yr	Bulb	0.15 to 0.45 m O.C.	Seed; bulb; bare root plant	Marshes; wet meadows; swamps	Partial shade	Muskrat; wildfowl; marsh birds	Regular to permanent inundation; <15 cm	Fresh to moderately brackish
Juncus effusus	Soft rush	Emergent; herbaceous	Perennial; persistent	Slow; <6 cm/yr	Rhizome	0.15 to 0.45 m O.C.	Seed; rhizome; bare root plant	Marshes; shrub swamps; wet meadows	Full sun	Wildfowl; marshbirds; songbirds; waterfowl	Regular to permanent inundation; <30 cm	Fresh water; <0.5 ppt
Lemna minor	Common duckweed	Non-rooted floating aquatic	Perennial; nonpersistent	Rapid	Fragmentation		Whole plant	Lakes and ponds	Partial shade	Ducks; gallinules; coots; rails; geese; beaver; muskrat; small mammals	Permanent inundation	Fresh water; <0.05 ppt
Nuphar luteum	Spatterdock	Rooted floating to emergent; herbaceous	Perennial; nonpersistent	Slow; <6 cm/yr	Rhizome	0.15 to 0.45 m O.C.	Bare root plant	Marshes; swamps; ponds	Partial shade	Ducks; muskrat; fish	Regular to permanent inundation; up to 1.8 m	Fresh water to infrequent brackish
Nymphea odorata	Fragent water lily	Rooted floating aquatic	Perennial; nonpersistent		Rhizome		Bare root seedling	Ponds and lakes	Partial shade	Cranes; ducks; beaver; muskrat; moose	Permanent inundation; 0.3 to 0.9 m	Fresh water; <0.05 ppt
Nyssa sylvatica	Black gum	Tree	Perennial; deciduous	Slow	Suckers		Seed; bare root plant	Forested wetlands; swamps	Partial shade	Ducks; woodpeckers; songbirds; aquatic furbearers	Irregular to permanent Inundation	Fresh water to infrequent brackish

Table C-2(cont.). Aquatic and Wetland Plants That Can Be Used in Constructed Wetlands.

Plant Species	Common Name	Growth Form	Persistence	Growth/Spread Rate	Vegetative Growth Method	Spacing	Propagules	Habitat	Shade Tolerance	Wildlife Benefits	Water Regime	Salinity Tolerance
Pontederia cordata	Pickerelweed	Emergent herbaceous	Perennial; nonpersistent	Moderate; 15 cm/yr	Rhizome	0.3 to 0.9 m O.C.	Rhizome; bare root plant	Fresh to brackish marshes; edges of ponds	Partial shade	Ducks; muskrat; fish	Regular to permanent; up to 30 cm	Fresh to moderately brackish; up to 3 ppt
Populus deltoides	Eastern cottonwood	Tree	Perennial; deciduous	Fast; 1.2 to 1.5 m/yr			Bare root plant; container	Forested wetlands	Full sun	Gamebirds; songbirds; waterfowl; aquatic furbearers; browsers	Seasonal inundation or saturation	Fresh water to infrequent brackish
Potamogeton nodosus	Long-leaved pond weed	Rooted submerged aquatic	Perrenial; nonpersistent	Rapid	Rhizome	0.6 to 1.8 m O.C.	Seed; bare root plant	Streams; lakes; ponds		Waterfowl; marshbirds; shorebirds; aquatic furbearers; moose; fish	Regular to permanent inundation; 0.3 to 1.8 m	Fresh water; <0.05 ppt
Quercus bicolor	Swamp white oak	Tree	Perennial; deciduous	Fast; 0.4 to 0.6 m/yr			Bare root plant; container	Forested wetlands	Partial shade	Waterfowl; marshbirds; shorebirds; gamebirds; songbirds; mammals	Irregular to seasonal inundation or saturation	Fresh water to infrequent brackish
Rosa palustris	Swamp rose	Shrub	Perennial; deciduous				Container	Fresh marshes; shrub swamps	Full sun	Songbirds; gamebirds	Irregular to regular soil saturation	Fresh water; < 0.5 ppt
Sagittaria latifolia	Duck potato	Emergent; herbaceous	Perennial; nonpersistent	Rapid; > 30 cm/yr	Runners; tubers	0.6 to 1.8 m O.C.	Tuber; bare root plant	Fresh marshes; swamps; edge of ponds	Partial shade	Ducks; swans; rails; muskrats; beaver	Regular to permanent inundation; up to 60 cm	Fresh water; <0.5 ppt
Salix nigra	Black willow	Tree	Perennial; deciduous	Fast; 0.9 to 1.8 m/yr	Suckers		Bare root; container	Fresh marshes; swamps	Full sun	Gamebirds; ducks; songbirds; woodpeckers; aquatic mammals	Irregular to permanent inundation	Fresh water; < 0.5 ppt
Scirpus acutus	Hardstem bulrush	Emergent; herbaceous	Perennial; persistent	Rapid	Rhizome	0.9 to 1.8 m O.C.	Seed; rhizome	Fresh tobrackish marshes	Full sun	Ducks; geese; swans; cranes; shorebirds; rails; snipe; muskrats; fish	Regular to permanent; up to 90 cm	Fresh to brackish
Scirpus americanus	Olney's bulrush	Emergent; herbaceous	Perennial; semi-persistent	Rapid; > 30 cm/yr	Rhizome	0.6 to 1.8 m O.C.	Rhizome; bare root plant	Brackish and alkali marshes	Full sun	Ducks; geese; swans; cranes; shorebirds; rails; snipe; muskrats; fish	Regular to permanent inundation; up to 30 cm	Fresh to brackish water; up to 15 ppt
Scirpus cyperinus	Wool grass	Emergent; herbaceous	Perennial; persistent	Moderate; 15 cm/yr	Rhizome	0.3 to 0.9 m O.C.	Rhizome; bare root plant	Fresh marshes; wet meadows; sloughs; swamps	Full sun	Ducks; geese; swans; cranes; shorebirds; rails; snipe; muskrats; fish	Irregular to seasonal inundation	Fresh water; < 0.5 ppt
Scirpus validus	Soft stem bulrush	Emergent; herbaceous	Perennial; persistent	Rapid; > 30 cm/yr	Rhizome	0.6 to 1.8 m O.C.	Rhizome; bare root plant	Fresh and brackish marshes	Full sun	Ducks; geese; swans; cranes; shorebirds; rails; snipe; muskrats; fish	Regular to permanent inundation; up to 30 cm	Fresh to brackish water; up to 5 ppt
Sparganium eurycarpum	Giant bur-reed	Emergent; herbaceous	Perennial; nonpersistent	Rapid; > 30 cm/yr	Rhizome	0.6 to 1.8 m O.C.	Seed; rhizome; bare root plant	Marshes; swamps; pond shorelines	Partial shade	Ducks; swan; geese; beaver; muskrat;	Regular to permanent inundation; up to 30 cm	Fresh water; < 0.5 ppt
Taxodium distichum	Bald cypress	Tree	Perennial; deciduous	Medium; 0.3 to 0.6 m/yr			Seed; bare root; container	Fresh water swamps; pond and lake margins	Partial shade	Perching and nesting site for birds	Irregular to permanent inundation	Fresh water; < 0.5 ppt
Typha angustifolia	Narrow-leaved cattail	Emergent; herbaceous	Perennial; persistent	Rapid; > 30 cm/yr	Rhizome	0.6 to 1.8 m O.C.	Rhizome; bare root plant	Fresh and brackish marshes; pond edges	Full sun	Geese; ducks; muskrats; beaver; blackbirds; fish	Irregular to permanent inundation; up to 30 cm	Fresh to brackish; up to 15 ppt
Typha latifolia	Broad-leaved cattail	Emergent; herbaceous	Perennial; persistent	Rapid; > 30 cm/yr	Rhizome	0.6 to 1.8 m O.C.	Rhizome; bare root plant	Fresh marshes; pond margins	Full sun	Geese; ducks; muskrats; beaver; blackbirds; fish	Irregular to permanent inundation; up to 30 cm	Fresh water; < 0.5 ppt

Source: Adapted with modifications from Thunhorst (1993).

APPENDIX E
WATERSHED MAP

Table C-3 Ecological and Silvicultural Characteristics																
Plant Name	Region			Wildlife Value				Growth Rate				Size			Rooting
Common Name	C. Plain	Piedmon	MTNS.	V. High	High	Med.	Low	V. Fast	Fast	Med.	Slow	>75'	50 - 75'	<50'	
RIPARIAN CANOPY															
Swamp white Cedar	+					+				+	+		+		shallow
Bald cypress	+	+					+			+		+			shallow
Black willow	=	+	+		+			+					+		shallow
E. Cottonwood		+	+				+		+			+			shallow
Red Maple	+	+	+	+					+	+			+		v. shallow
Sugar Maple	+	+	+	+											
Swamp white oak	+	+			+				+	+		+			shallow
Blackgum	+	+	+			+					+			+	taproot
Green ash	=	+	+				+	+					+		shallow
Silver Maple	+	+	+	+				+		+		+			v. shallow
Sycamore	+	+					+	+					+		shallow
River birch	+	+	+	+					+				+		shallow
Grey birch	+	+	+	+											
Yellow birch	+	+	+	+											
Pin oak	+	+			+				+	+		+			shallow
Willow oak	+	+			+				+	+		+			shallow
Hackberry	+	+	+	+					+	+		+			deep lateral
Pitch Pine	+						+			+	+			+	shallow
American beech	+	+			+					+	+	+			shallow
Sweetgum	+	+					+			+			+		deep taproot
Black walnut	=	+	+				+		+			+			taproot
Bitternut hickory	+	+	=			+				+	+	+			deep taproot
Persimmon	+	+			+						+			+	deep taproot
White ash	=	+	+				+			+		+			shallow
Tulip poplar	+	+	+				+		+	+		+			shallow/deep
White oak	=	+	+	+	+						+	+			deep taproot
Red oak	=	+	+		+					+		+			deep lateral
Basswood		+	+				+			+			+		deep lateral
American Holly															
Eastern Red Cedar	+	+	+	+									+		
Shagbark hickory	+	+	+												
Smooth hickory	+	+	+		+										
RIPARIAN UNDERSTORY												>40'	40-30'	<30'	
Box elder	=	+	+	+				+				+			deep lateral
Common alder		+	+			+			+					+	shallow
Sweet bay	+	+					+			+				+	deep lateral
Black Haw		+	+		+					+				+	shallow
Possumhaw	=	+	+		+					+	+			+	shallow
Witch hazel		+	+				+			+			+		deep lateral
Shadblow		+	+		+						+		+		shallow
Pawpaw		+		+							+		+		deep lateral
Hornbeam		+	+	+							+		+		deep lateral
Redbud		+	+				+		+	+			+		shallow
Flowering Dogwood		+	+			+					+		+		shallow
RIPARIAN SHRUBS															
Buttonbush	+	+	+				+			+			+		shallow
Pussy willow		+	+		+				+			+			shallow
Sweet pepperbush	+	+			+					+	+		+		shallow
Swamp azalea	+	+					+			+		+			shallow
Winterberry	+	+			+						+	+			shallow

Table C-3 Ecological and Silvicultural Characteristics

Plant Name	Region			Wildlife Value				Growth Rate				Size			Rooting
Common Name	C. Plain	Piedmon	MTNS.	V. High	High	Med.	Low	V. Fast	Fast	Med.	Slow	>75'	50 - 75'	<50'	
Arrowwood	+	+	+		+					+		+			shallow
Highbush blueberry	+	+		+							+		+		shallow
Elderberry	+	+	+	+					+			+			shallow
Virginia sweetspire		+	+				+			+	+			+	shallow
Inkberry	+	=			+						+			+	shallow
Swamp leucothoe	+	+					+				+			+	shallow
Pinxterbloom azalea	+	+					+				+		+		shallow
Bayberry	+				+					+			+		shallow
Silky dogwood		+	+	+					+				+		shallow
Common ninebark	+	+				+			+					+	shallow
Red chokeberry	+					+					+			+	shallow
Spicebush	+	+	+	+							+		+		deep lateral
Grey dogwood		+	+	+						+			+		shallow
Rosebay Rhododendron	+	+	+				+				+	+			shallow
Mapleleaf viburnum		+	+		+					+	+		+		shallow
Red osier dogwood	=	+	+	+	+									+	
Smooth sumac					+									+	
Staghorn sumac	+	+	+		+									+	
Nanny berry		+	+		+									+	
Blackhaw viburnum					+									+	
FORBS AND FERNS												>6'	3-6'	<3'	TYPE
Jewelweed	+	+	+		+					+			+		annual
Smartweed	+	+			+				+					+	annual
Royal Fern		+	+				+		+					+	fern
Sensitive Fern		+	+				+		+					+	fern
Joe Pye Weed	+	+	+			+			+				+		perennial
Swamp Dewberry	=	+	+		+				+					+	perennial
Thimbleberry	=	+	+		+				+				+		perennial
Rasberry	=	+	+		+				+				+		perennial
GRASSES												>6'	3-6'	<3'	
Switchgrass	=	+	+	+					+				+		warm, clump
E. Gamagrass	+	+		+					+				+		warm, clump
Field Bromegrass	=	+	+		+				+					+	w. annual
Fowl Meadowgrass	=	+	+		+				+					+	cold, sod
Deertongue	=	+	+		+				+					+	warm, clump
Tall fescue	=	+	+			+			+					+	cold, sod
Indiangrass	=	+	+		+				+			+			warm, sod
Purpletop	=	+	+		+				+				+		warm, clump
Big Bluestem	=	+	+		+					+		+			warm, clump
Little Bluestem	=	+	+		+					+				+	warm, clump

+ characteristic/preferred

= tolerant

Source: Adapted with modifications from Palone and Todd (draft).

APPENDIX D
STORMWATER MANAGEMENT PLAN APPLICATION AND FEE SCHEDULE

HILLTOWN TOWNSHIP

13 West Creamery Road
P.O. Box 260
Hilltown, PA 18927-0260
(215) 453-6000 Fax (215) 453-1024
www.hilltown.org

HILLTOWN TOWNSHIP STORMWATER MANAGEMENT PLAN APPLICATION

A completed application form and fee must be submitted with three (3) copies of required associated plans, and documents to Hilltown Township Municipal Building, 13 West Creamery Road, Hilltown, PA 18927.

Date: _____

Name of Development: _____

Tax Map Parcel No.: _____

Name of Applicant: _____ Telephone No. (___) _____

Mailing Address: _____

_____

Name of Property Owner: _____ Telephone No. (___) _____

Mailing Address: _____

_____

Name of Design Engineer: _____ Telephone No. (___) _____

Mailing Address: _____

_____

Type of development proposed: _____ Residential _____ Industrial _____ Commercial _____ Other

Total parcel size _____ AC

Total amount of new impervious surface _____ SF

Minimum distance between proposed impervious surface and nearest downstream property boundary – _____ FT

Exemption of Stormwater Management Ordinance Requirements requested? _____ Yes _____ No

Checklist of Stormwater Management Plan Requirements:

_____ Three (3) copies of plan (signed and sealed by responsible engineer).

_____ Three (3) copies of stormwater narrative and calculations (signed and sealed by responsible engineer).

_____ Three (3) copies of onsite soil test results (certified by responsible soil scientist) for feasibility of use of infiltration stormwater management facilities.

_____ Three (3) copies of the "Engineer's Opinion of Probable Cost" for use in determining the Performance Guarantee.

I hereby certify that to the best of my knowledge, the above information is true and correct.

Signature: _____ Date: _____
Applicant or Agent for Applicant

To be completed by the Township

Date application received _____

Permit filing fee $_____

Escrow $_____

Township Account # _____

Received by _____

RESOLUTION #
HILLTOWN TOWNSHIP, BUCKS COUNTY

BE IT RESOLVED THAT THE FOLLOWING FEES/ESCROWS SHALL BE REQUIRED PURSUANT TO SECTION 601 OF THE HILLTOWN TOWNSHIP STORMWATER MANAGEMENT ORDINANCE NO. _____:

I. Plan Review: (per lot for Subdivision Applications)

Fee:	$100.00
Escrow:	$400.00 – for one to five lots
	$100.00 – for each additional lot over five lots

II. Permit/Inspection:

Fee:	$25.00
Escrow:	$200.00

III. Stormwater Management Capital Fund Fee:

2,000 S.F. or less impervious surface:	$500.00
more than 2,000 S.F. of impervious surface:	$500.00 plus $0.50/S.F. of impervious surface over 2,000 S.F.

All fees are non-refundable. The applicant shall be responsible to reimburse the Township for all costs for plan review or administration/inspection which exceed the escrow amount established by this resolution. Any escrow remaining upon project completion will be returned to the applicant.

BE IT RESOLVED, by the Board of Supervisors of Hilltown Township, Bucks County, this _____day of _____, 2002.

HILLTOWN TOWNSHIP
BOARD OF SUPERVISORS:

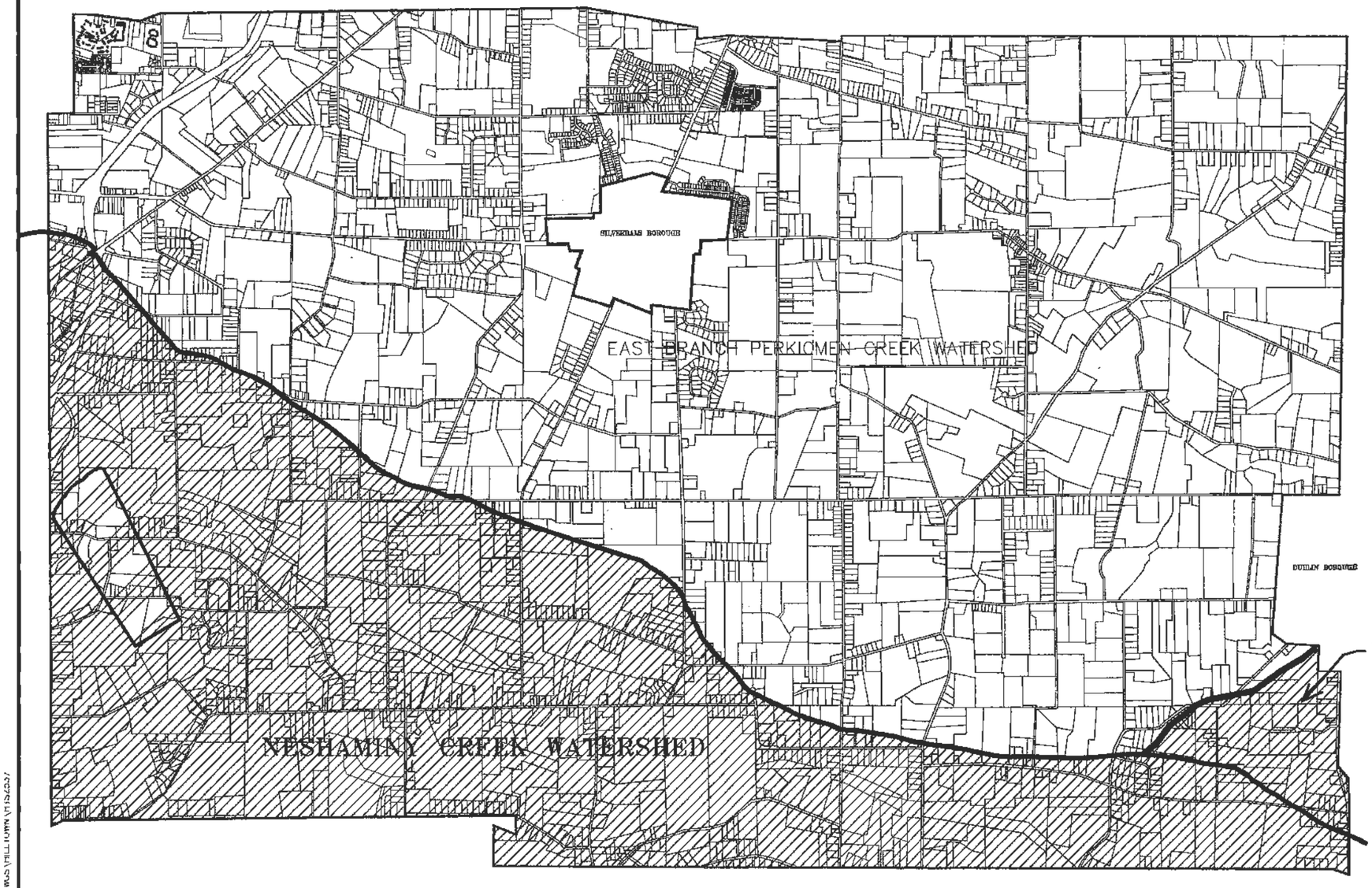
_____
Mr. John Bender, Chairperson

_____
Mr. Kenneth B. Bennington, Vice Chairperson

_____
Ms. Betty P. Snyder, Member

ATTEST:

_____
Mr. Greg Lippincott, Township Manager



WATERSHED BOUNDARY

RELEASE RATE DISTRICTS

DIRECT DISCHARGE

100% RELEASE RATE

STORMWATER MANAGEMENT RELEASE RATE MAP

HILLTOWN TOWNSHIP

BUCKS COUNTY PENNSYLVANIA

0 800 1600 3200 4800 6400

1" = 800'